

**EIS  
SUB-APPENDIX H**

**CHARACTERIZATION OF ESSENTIAL FISH HABITATS  
IN THE PORT EVERGLADES EXPANSION AREA**

**FINAL  
FEASIBILITY REPORT  
AND ENVIRONMENTAL IMPACT STATEMENT  
PORT EVERGLADES HARBOR NAVIGATION STUDY  
BROWARD COUNTY, FLORIDA**



**DEPARTMENT OF THE ARMY**  
**JACKSONVILLE DISTRICT CORPS OF ENGINEERS**  
P.O. BOX 4970  
JACKSONVILLE, FLORIDA 32232-0019

REPLY TO  
ATTENTION OF

AUG 14 2014

Planning and Policy Division  
Environmental Branch

Dr. Roy Crabtree, Ph.D.  
Regional Administrator  
National Marine Fisheries Service  
263 13<sup>th</sup> Avenue South  
St. Petersburg, Florida 33701-5505

Dear Dr. Crabtree:

The purpose of this letter is to provide an update to the National Marine Fisheries Service on proposed changes to the proposed Port Everglades Harbor Deepening Project and updated responses to the Service's Essential Fish Habitat (EFH) Conservation Recommendations. We appreciate the collaborative efforts of your staff in the development of significant beneficial revisions to the proposed project, including the blended coral reef mitigation plan.

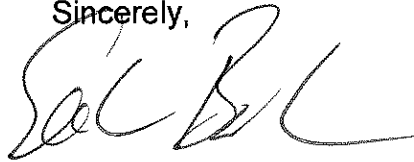
Under the applicable provisions of the Magnuson-Stevens Act, the Service provided EFH Conservation Recommendations by letter dated August 13, 2013. Jacksonville District responded by letter to those recommendations by letter dated October 11, 2013. However, since that time, the project has undergone significant modifications, including an updated functional impact assessment and development of the blended (artificial reef construction plus coral propagation and outplanting) mitigation plan offsetting unavoidable impacts to hardbottom areas.

As discussed with members of your staff by conference call June 20, 2014, I am providing updated responses to the Service's August 13, 2013 Conservation Recommendations, taking into account revisions to the project since that date. To assist your review, copies of the revised mitigation plan and survey drawings from Corps maintenance dredging performed in 2005 and 2013 are provided. These updated responses and information complete the Jacksonville Districts' requirements under the Magnuson-Stevens Act and we consider the consultation to be concluded.

The draft feasibility report and draft EIS are still being reviewed internally for technical and policy compliance by the Corps. Although we do not expect substantive changes, some of the information and analyses contained in the draft report/EIS may be updated further as a result of final technical and policy reviews. In addition, revisions to some sections and appendices are still being developed.

The complete revised report, including a discussion of the path forward for continuing coordination efforts on the monitoring plan, will be provided to your office once we receive approval from our headquarters. Please contact me at 904-232-1517 or Mr. Jason Spinning, telephone 904-232-1231 for further information or assistance.

Sincerely,

A handwritten signature in dark ink, appearing to read 'Eric L. Bush', written in a cursive style.

Eric L. Bush  
Chief, Planning and Policy Division

3 Encls

1. Responses to Conservation Recommendations
2. Updated Coral Reef Mitigation Plan
3. Survey Drawings of Maintenance Dredging (2005, 2013)

Copies Furnished:

Mr. Mark Thomasson, Florida Department of Environmental Protection, 2600 Blair Stone Road, M.S. 3560, Tallahassee, Florida 32399

Ms. Danielle Irwin, Florida Department of Environmental Protection, 2600 Blair Stone Road, M.S. 3560, Tallahassee, Florida 32399

Ms. Lauren Milligan, Florida Department of Environmental Protection, 2600 Blair Stone Road, M.S. 3560, Tallahassee, Florida 32399

## **RESPONSES TO CONSERVATION RECOMMENDATIONS**

### ***1. The USACE shall provide a mitigation plan that assumes no less than 21.66 acres of direct impacts to coral reef and hardbottom habitats.***

The Corps has revised the hardbottom impact assessment to reflect a total impact area of 21.70 acres of potential impacts in the Outer Entrance Channel (OEC) footprint. Through coordination with NMFS and other resource agencies and after policy review by our higher headquarters, we revised the Habitat Equivalency Analysis (HEA) and Mitigation Plan/Incremental Cost Analysis to reflect this impact and associated mitigation.

Of the 21.70 acres of coral reef within the area to be dredged, the Corps believes 15.33 acres will be 100% impacted through total removal of habitat, whereas 6.37 acres of reef may be subjected to impacts from sediment loading or impacts from rubble moving from the construction area down-slope to areas below dredging depth. The mitigation plan provides compensation for the 100% functional losses associated with 15.33 acres of direct habitat removal and 100% functional loss for 10% of the 6.37 acres of potential impacted area below dredging depth. Construction monitoring will determine the need for and extent of additional compensation necessary to offset impacts greater than the 10% already addressed. Per the Terms and Conditions listed in the March 7, 2014 Biological Opinion issued by NMFS, the Corps will work with NMFS and other agencies to refine the plan for monitoring impacts to the remaining 5.73 acres of coral reef located deeper than the authorized depth.

### ***2. The USACE shall provide a mitigation plan that assumes no less than 19.31 acres of anchor impacts, in the case that the dredge equipment selection requires anchoring outside the federal channel.***

While the extent of potential impacts to coral reef and hardbottom habitat from dredging equipment anchoring outside the channel and the amount of mitigation needed have not been determined, should dredging equipment anchor outside of the area to be dredged, monitoring will be conducted to determine actual impacts outside the channel and the Corps has committed to mitigate as needed to offset functional losses. We have included a contingency line-item in the total project cost estimate to provide mitigation for impacts caused by anchor-cables. The mitigation would be achieved by increasing the number of propagated/transplanted corals consistent with the HEA-based coral plan.

### ***3. The USACE shall provide a monitoring plan to evaluate physical and biological impacts that may occur outside the channel. This plan shall reflect substantial input by NMFS.***

The Terms and Conditions of the Biological Opinion issued by NMFS require the Corps to work with NMFS and other resource agencies to refine the monitoring plan and evaluate its effectiveness during project implementation.

The Corps is committed to incorporating lessons learned from the monitoring at Port of Miami and other similar projects into the monitoring plan for the Port Everglades project. See the response to CR 1 for coral reef impact monitoring of areas deeper than the authorized depth.

***4. The USACE shall provide a mitigation plan that reflects no less than 111.87 acres of indirect impacts that would occur in the 150 meter zone surrounding the federal channel. The final EIS should clearly describe how the amounts of indirect impacts to coral reefs are determined.***

Inclusion of indirect impacts in the updated HEA report addresses this issue.

***5. In the case that blasting is required; USACE shall work with NMFS and other resource trustees to develop a monitoring program. Substantial input from NMFS shall be reflected in the final blasting monitoring plan.***

The Corps included a monitoring plan to evaluate the potential effects associated with confined underwater blasting in the Draft EIS as part of Appendix E-5, beginning on page 9. This monitoring plan was based on the previously permitted and constructed Miami Harbor Phase II project, where confined underwater blasting was conducted, as well as the Miami Harbor expansion project (currently underway). The monitoring plan was previously coordinated with FWC, USFWS, and NMFS-PRD for their input regarding protected species that may be in the project vicinity. The proposed Port Everglades plan replicates the plan prepared for the Miami Harbor expansion, permitted by the state and previously consulted on under the Endangered Species Act by USFWS and NMFS. As stated on page 1 of the confined underwater blasting monitoring plan, any lessons learned from Miami Harbor will be incorporated into the monitoring plan prior to construction activities at Port Everglades to ensure the most recent information is utilized.

***6. The USACE shall update the HEA with scientifically defensible inputs on equivalency of natural coral reefs and boulder piles, recovery rates of dredged coral reef habitat, recovery rates of boulder piles, and discount rates. The final HEA shall reflect actual costs of boulder piles with substantial input from NMFS.***

Updated values for the HEA were agreed upon by NMFS and the Corps during the April 17, 2014 meeting in St. Petersburg, FL. The Corps will provide NMFS with the updated HEA and mitigation plan reflecting these changes. In addition, the Corps agrees to acknowledge in the final EIS that NMFS has a different view on discount rates than Corps policy.

***7. The USACE shall adopt a compensatory mitigation plan that is the most technically sound approach to offsetting the loss of coral, coral reef, and hardbottom habitat. The final coral reef mitigation plan shall not take credit twice for coral relocation. The final coral reef mitigation plan shall reflect input from NMFS.***

See response to EFH CR 6.

**8. As a project minimization measure, the USACE shall relocate all corals in accordance to Table 2 in the draft EIS Appendix E-4. Coral relocation shall occur in expansion areas and previously dredged areas. The Coral relocation plan should include clearly defined performance standards, monitoring protocols, and schedule.**

The blended mitigation plan includes relocation of all corals  $\geq 10$  cm that are within the area of direct impacts. These corals will be relocated to both constructed boulder reefs and/or adjacent natural hardbottom areas prior to dredging.

The Corps acknowledges NMFS' request to relocate corals  $< 10$  cm. The Corps appreciates NMFS sharing publications that examine the feasibility of such relocation, but the Corps has concluded it is cost-prohibitive and not practicable (based on survival rates) to move corals smaller than 10 cm. If credible new information becomes available to better assess the practicability of this relocation, the Corps will consider it and coordinate further with NMFS and other resource agencies.

Also, see response to CR1.

**9. The USACE shall update the EIS to evaluate the potential for the deepening and widening of the OEC to create a "sink" or trench whereby coral fragments and larvae moving northward or southward along the reef line fall into the channel and become no longer viable. This update to the EIS shall reflect significant input from NMFS.**

Jacksonville District does not agree with NMFS' determination that the deepening and widening of the OEC would create a "sink" adversely affecting coral reproduction. We included a detailed assessment of this concern in Section 4.5.10.2.2 of the draft EIS as well as in the September 2012 Biological Assessment provided as part of the ESA consultation. These actions address this recommendation.

**10. The USACE shall update the EIS to describe no less than 8.45 acres of seagrass habitat impacts. The EIS shall be updated to include historically mapped and ground-truthed seagrass habitat areas that would be eliminated by dredging and no longer available as contraction and expansion habitat.**

At the meeting between NMFS and the Corps on April 17, 2014, the Corps agreed to a base mitigation plan compensating for 4.01 acres of impact to vegetated areas and to include a contingency cost estimate to mitigate for up to 8.45 acres of impact (including areas within the project footprint previously consulted on and currently unvegetated seagrass habitat not within prior maintenance-dredged areas). The amount of mitigation is to be based on future pre-construction surveys.

All credible scientific information regarding the functional value of ephemeral seagrass habitat will be considered at that time to determine the amount of additional mitigation, if any. The Feasibility Report and EIS will be revised to reflect this commitment. The Corps is also providing NMFS with survey drawings of areas that have been maintenance-dredged by the Corps relative to locations where seagrass has been observed in or near the project footprint.

***11. The USACE shall update the EIS to describe indirect impacts to seagrass habitat. This update shall reflect input from NMFS. Specifically, NMFS requests USACE update the EIS to identify each seagrass impact polygon on a map and provide a narrative that explains how the impact area was calculated for each seagrass impact area.***

The Draft EIS discusses the potential for indirect effects to seagrasses in Sections 4.4.1.2. The Corps will include electronic maps of each seagrass polygon on the CD with the final EIS as an appendix and provide separately to NMFS; however, these will not be printed in the EIS. Each of the individual seagrass assessment reports includes a description of the methodology utilized to map these habitats.

***12. The USACE shall develop supplementary compensatory mitigation for seagrass impacts to account for the loss of all seagrass habitat that has been historically mapped and ground-truthed and will become unavailable as habitat after the dredging occurs. The additional mitigation shall appropriately address seagrass impacts that occur closer to or within the inlet. The plan shall address how the site selection for mitigation locations is supported by the best available literature. This plan should include clearly defined performance standards, monitoring protocols, and schedule. The mitigation amounts shall be based on a functional assessment that reflects NMFS and other resource trustee input.***

The Corps acknowledges the amount of seagrass mitigation is contingent upon the outcome of CR 10. The Corps also acknowledges the amount of seagrass credits available at West Lake Park may not be sufficient to meet mitigation obligations. Once the final seagrass impact acreage is determined the Corps will work with NMFS and other resource agencies to develop other mitigation alternatives, if required. This commitment will be included in the final EIS.

***13. The USACE shall update the cumulative impacts section and description of cumulative impacts to coral reefs and water quality. The EIS should be updated to acknowledge the findings of Walker et al. (2012) that Port Everglades has historically dredged 58.5 acres of hardbottom and buried 178 acres of Outer Reef as dredged material disposal, which resulted in the loss of over six million corals and approximately 180 acres of live coral tissue area.***

The Corps agrees to update the EIS to include findings presented in Walker et al. (2012); however, the Corps believes the coral cover estimates presented in that study are high and refer to habitat burial not caused by port dredging. Regardless of the cause of the impact, the Corps agrees that the impacts should be included in a discussion of cumulative impacts in the final EIS.

***14. The USACE shall require use of best management practices (BMP) to avoid and minimize the degradation of water quality and minimization impacts to hardbottoms an seagrass habitat, including the use of staked turbidity curtains around the work areas marking of seagrass and hardbottom habitat to facilitate avoidance during construction, and prohibiting staging, anchoring, mooring, and spudding of work barges and other associated vessels over seagrass and hardbottom. These BMPs shall be coordinated with NMFS for approval prior to commencement of work.***

The Corps requires contractors to utilize best management practices (BMP) in all construction projects, and the EIS specifically listed BMPs that would be employed in Section 4.4.2.2 of the EIS. However, by federal law, only the Contracting Officer or the Contracting Officer's Representative may approve contractor's submittals and plans, and as such, NMFS can not be given approval authority over any aspect of the construction associated with Port Everglades. However, the Corps will work with NMFS and other resource agencies to provide opportunities to review draft plans and specifications developed for the project, as we have previously done to address specific resource concerns on other projects.

# **Port Everglades Navigation Improvements- Draft Comprehensive Mitigation Plan and Incremental Cost Analysis**

Prepared for



**Jacksonville District  
U.S. Army USACE of Engineers  
Jacksonville, Florida**

by



**Dial Cordy and Associates Inc.  
Jacksonville Beach, Florida**

**With Input by NOAA-Fisheries as a Cooperating Agency under NEPA**



**Revised – July 2014**

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APPENDIX E-5 Mitigation, Monitoring and Adaptive Management Plan

## FRAMEWORK

In accordance with Section C-3(b)(12)(e) of ER-1105-2-100 (ER-100), mitigation opportunities are under consideration to compensate for effects caused by the proposed project. The Jacksonville District began the mitigation process early in feasibility study, by determining a rough estimate of the potential impacts followed up with potential mitigation measures and a rough order of magnitude cost for those measures. The Jacksonville District worked with other resource agencies and the local sponsor to develop a variety of mitigation alternatives to address the specific impacts associated with the project.

From a broad perspective, mitigation planning consists of the following three major steps: 1) Avoid Impacts, 2) Reduce Impacts, and 3) Replacement/Compensation. Mitigation (or Replacement/Compensation) can include restoration, enhancement, establishment, and preservation. Whichever option is chosen it should offset impacts, it should be practicable, and it should be environmentally preferable. The hierarchy for mitigation alternatives from the Mitigation Rule (33 CFR 332) is as follows:

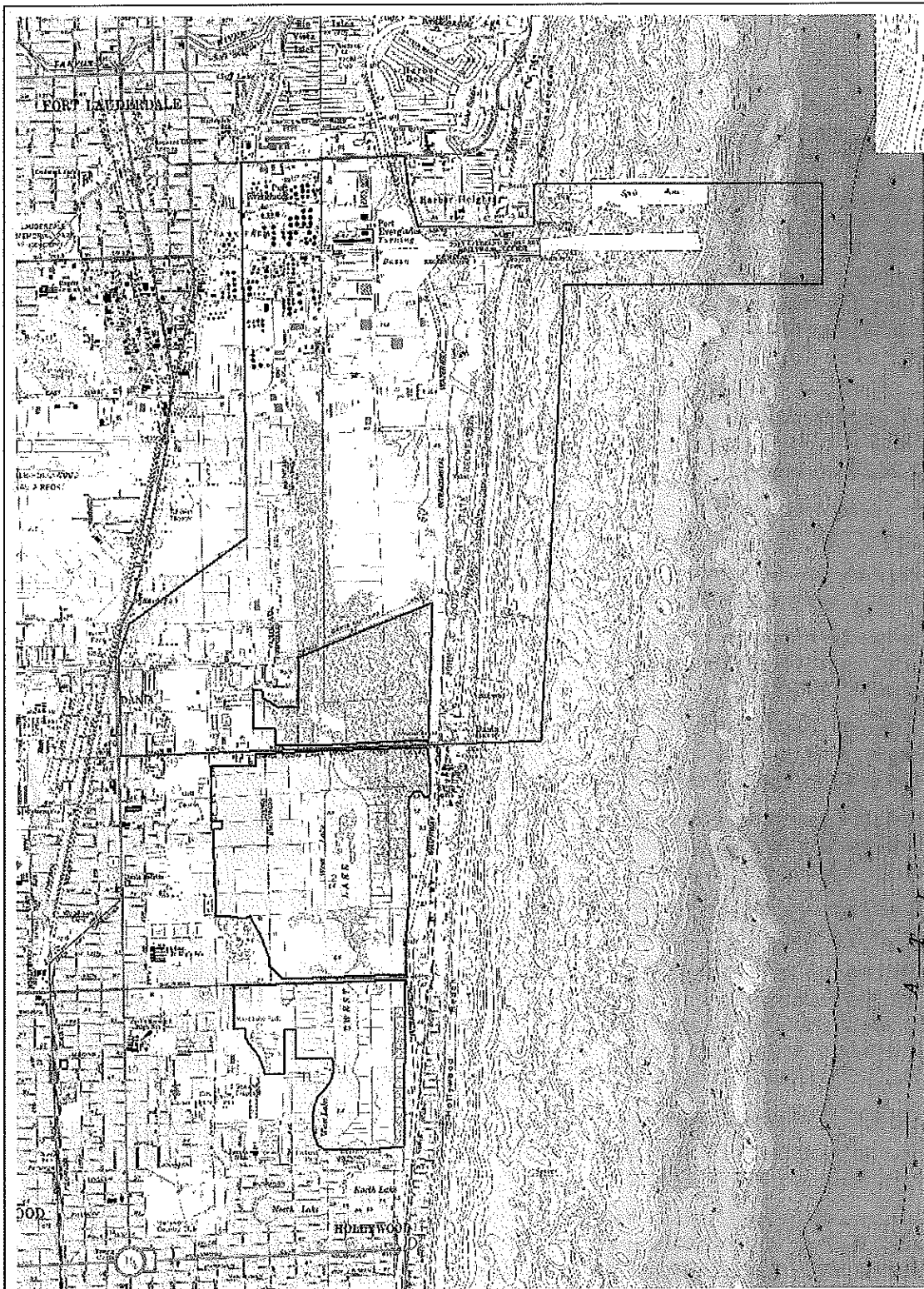
1. Mitigation Bank credits
2. In-Lieu fee program credits
3. Permittee-responsible mitigation under a watershed approach
4. On-site and/or in-kind permittee-responsible mitigation
5. Off-site and/or out-of-kind permittee-responsible mitigation

Although the Corps intends to avoid adverse impacts to the environment, rarely can a major construction project be implemented without causing some adverse effects. The type, location, and level of these impacts must be known before actions can be evaluated to avoid those impacts, reduce those impacts or provide appropriate mitigation. Most impacts that could be expected to occur from this proposed project would result from either loss of wetlands adjacent to the (expanded) navigation channel or turning basins, a transition from one wetland type to another upstream of the project, or changes to the aquatic environment within the harbor. Other potential impacts could also result, such as changes in shoreline erosion, salinity intrusion into the groundwater, air emissions, etc. The following summaries describe the preliminary rough estimates of the project impacts and potential measures to mitigate those impacts. All numbers and costs are intended to be used for preliminary planning and rough order of magnitude benefit cost analysis only.

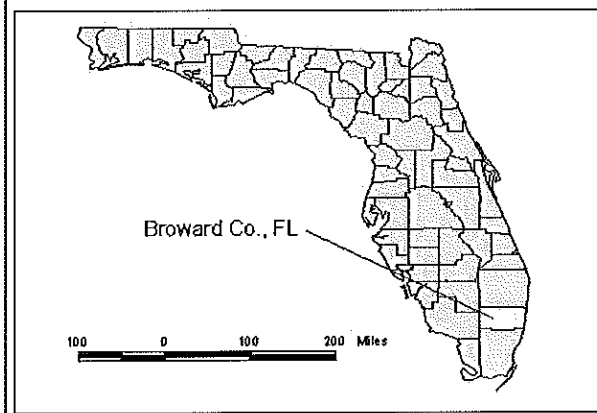
## 1.0 PROJECT OVERVIEW

The Port Everglades (Port) is a major seaport located on the southeast coast of Florida (Figure 1). The Port has immediate access to the Atlantic Ocean, and is located within parts of the cities of Hollywood, Dania Beach, and Fort Lauderdale. To the east of the Port is a barrier island that contains a U.S. Navy (USN) facility, a Nova Southeastern University (NSU) facility, a U.S. Coast Guard (USCG) facility, and John U. Lloyd Beach State Park (JUL) and its adjacent beaches. South of the Port's Dania Cutoff Canal (DCC) is the West Lake Park (WLP) area. West of the Port is Federal Highway (U.S. 1) which is flanked by the Fort Lauderdale International Airport (FTL). North of the Port is a mixture of small-craft waterways (Intracoastal Waterway and canals) and commercial and residential development.

The existing federal channel depth of 42 feet at Port Everglades does not provide an adequate, safe depth for large tankers and container ships currently visiting the harbor. Those ships must light-load or wait on tides to enter the harbor resulting in transportation inefficiencies and additional expenses. Additionally, the next generation of container ships requires significantly more channel depth to operate efficiently and safely. Specifically, the next generation of container ships comprises post-Panamax vessels, such as the *MV Susan Maersk* with an overall length of 1,138 feet, an extreme breadth of 141 feet, and a maximum draft of 47.6 feet. In contrast, the current largest Panamax



3000 0 3000 6000 Feet



**LEGEND**

☐ Approximate Study Limits  
☐ West Lake Park Boundary (approx.)



West Lake Park Location	
Port Everglades Navigation Mitigation Plan	
Scale: 1" = 3,000'	Drawn By: MR
Date: February, 2002	Approved By:
<b>DIAL CORDY</b> AND ASSOCIATES, INC. <small>INCORPORATED</small>	J00-466
	Figure 1

The Port's 20-year Master/Vision Plan agreement with the Florida Department of Environmental Protection (FDEP) includes expansion of the TN to increase berth capacity. This 400-foot expansion includes the release from the existing 48.27-acre conservation easement of approximately 8.68 acres west of the TN, and deepening the entire notch to 42 feet MLLW. The notch expansion is considered a future without-project condition, and is the sole responsibility of the sponsor, the Port

To achieve the above expansion and reconfiguration in accordance with the LPP, several resource types will be impacted. These are listed below in Table 1. The existing condition and value of the impacted resources, and anticipated future-without-project condition of these resources, are discussed in detail in the Environmental Impact Statement (Sections 3.5.2, 3.6.1, and 3.6.2; and Sections 4.3.1, 4.4.1.1, and 4.4.2.1, respectively).

USACE guidance on mitigation states that mitigation will be conducted for "significant" ecological resources compared to the future without plan condition. The habitat types noted in Table 1 classified as "Resources for which mitigation is proposed" are jurisdictional mangrove wetlands, seagrass beds, and hardbottom/reef habitats that have not been previously dredged. For areas within the LPP's footprint that were previously dredged and which will return to their current state in a relatively short time period, such as silt/sand bottom, and channel walls, mitigation will not be provided (USACE ER 1105-2-100, Appendix C (Environmental Evaluation and Compliance) Appendix C (Paragraph C-3.d (4)(b))).

To compensate for unavoidable impacts to these habitat types, USACE has proposed a mitigation plan that will restore the ecosystem functions lost due to removal of wetland, seagrass, and hardbottom habitats in areas that were not previously dredged. The functional value of each of these is briefly discussed below. Additional details may be found in the Environmental Impact Statement.

**Mangroves.** Mangroves are the dominant wetland type within the study area. Mangroves also represent the largest natural habitat within the project boundaries, and are found in both natural and created wetlands. These habitats comprise either stands of red mangrove (*Rhizophora mangle*) or mixed stands of red mangrove and black mangrove (*Avicennia germinans*). Major associates include white mangrove (*Languncularia racemosa*) and buttonwood (*Conocarpus erectus*). Mangroves are important for shoreline protection and stabilization. In addition, mangrove habitats provide many important ecological functions, including providing refugia for juvenile stages of managed fish species, and have been identified as significant resources for seven federally protected species, and four federally protected subspecies (Odum and McIvor 1990). These systems also provide organic matter that forms the basis of a littoral-zone, marine food web. Sloughs (channels of slow-moving water) penetrate mangrove wetlands adjacent to channel areas. Some of these sloughs are natural, while some are man-made. These are extremely important areas that provide species with passageways for movement into and out of interior mangrove areas. They are also important for refuge and feeding areas for various fishes and invertebrates. These habitats are important within Broward County since the County is urbanized and most of the previously existing mangrove habitat has been removed.

The largest (by area) mangrove habitats in the project area occur along the western shore of JUL and north and west of the TN. Some fringing mangrove wetlands in JUL comprise habitat created by the Port as mitigation for previous impacts to native areas of mangrove. Mangroves to the north and west of the TN fall under a FDEP conservation easement. Sloughs, both manmade and natural, are associated with both of these major mangrove areas.

**Seagrasses.** The Port project area supports sub-tropical and tropical seagrass communities including *Halophila decipiens* (paddle grass), *Halodule wrightii* (shoal grass), *H. johnsonii* (Johnson's seagrass), and associated green calcareous and brown algae, such as *Penicillus* spp., *Halimeda* spp. and *Caulerpa* spp. Seagrasses colonize soft sediments, generally at the edge of the channel, starting in the IEC, going south to beyond the DCC. These seagrass beds are valuable to fish, manatees and invertebrates which use them as nursery and foraging grounds within Broward County. Since most of the marine inland waters within Broward County are artificially constructed and channelized, suitable habitat for seagrass beds is limited within Broward County.

**Hardbottom and Coral Reef.** The reef complex within the project area is comprised of a nearshore ridge complex, and a seaward succession of three shore-parallel reefs referred to as the "inner," "middle," and "outer" reefs, or the "first," "second", and "third" reefs, respectively (Goldberg 1973; Moyer *et al.* 2003; Banks *et al.* 2007). The nearshore ridge complex runs parallel to the shore and is made up of carbonate/quartz sandstone and coquina rock (Banks *et al.* 2007). The nearshore ridge complex occurs in 0-12 feet (0-4 m) of water and hosts a hardbottom community of algae, sponges, encrusting octocorals, and hard corals (CSA 2009). These hardbottom communities exist in a dynamic environment, and may be periodically covered and uncovered by sands as a result of storms and/or littoral transport. Seaward of the nearshore ridge complex, the inner reef occurs from approximately 100 to 2,000 feet (30 to 610 m) from shore and crests at 26 feet below MHW (8 m); the middle reef is located 3,000 to 6,000 feet (914 to 1,829 m) from shore in 49 feet (15 m) of water (MHW); and the outer reef is approximately 8,000 feet (2,438 m) or more offshore and crests at 52 feet below MHW (16 m) (USACE 1996; Banks *et al.* 2007). The troughs between the inner and middle, and middle and outer reefs are characterized by sand and coral rubble with isolated patches of hardbottom and hard corals (USACE 1996).

Hardbottom and coral reefs in the project area are dominated by fauna typical of the wider-Caribbean basin (Goldberg 1973). These include in order of abundance, octocorals, sponges and hard corals (DC&A 2009; Moyer *et al.* 2003; Goldberg 1973). These reefs have been characterized as octocoral dominated reefs (Moyer *et al.* 2003; Goldberg 1973). Goldberg (1973) described the rich diversity of octocoral species characteristic of this reef system. Thirty-nine species of octocorals were found to be represented including *Eunicea*, *Plexaura*, and *Pseudopterogorgia*, and twenty-seven species of scleractinian corals have been documented (Goldberg 1973). The predominant hard coral genera in S. Florida include *Siderastrea*, *Montastraea*, *Stephanocoenia*, and *Porites* (DC&A 2009). Recently, 45 hard coral species were documented in Broward County by Banks *et al.* (2009), while, Moyer *et al.* (2003) found 30 across the county. Nineteen hard coral species were found on the middle and outer reefs within and adjacent to the project area in 2006 (DC&A 2009). Typical sub-tropical sponges are found along the reefs, including, but not limited to members of *Ircina*, *Agelas*, *Iotrochota*, *Verongula*, and *Xestospongia* genera (DC&A 2009). Associated sub-tropical fish species use the reef for foraging, shelter, and breeding habitat.

### 3.0 MITIGATION PLANNING AND POLICIES

Compensatory mitigation is intended to replace the ecological services that are lost as a result of unavoidable impacts to resources affected by a given project. "Ecological services" refer to the services performed by a resource for the benefit of other resources or the public. The baseline for quantifying lost ecological services is the full complement of services that would have been provided absent project implementation. Lost ecological services are quantified as the reduction in the provision of services below this baseline. Compensatory mitigation must restore services

"the required compensatory mitigation should be located within the same watershed as the impact site, and should be located where it is most likely to successfully replace lost functions and services, taking into account such watershed scale features as aquatic habitat diversity, habitat connectivity, relationships to hydrologic sources (including the availability of water rights), trends in land use, ecological benefits, and compatibility with adjacent land uses. When compensating for impacts to marine resources, the location of the compensatory mitigation site should be chosen to replace lost functions and services within the same marine ecological system (e.g., reef complex, littoral drift cell). Compensation for impacts to aquatic resources in coastal watersheds (watersheds that include a tidal water body) should also be located in a coastal watershed where practicable. Compensatory mitigation projects should not be located where they will increase risks to aviation by attracting wildlife to areas where aircraft-wildlife strikes may occur (e.g., near airports)."

The proposed mitigation for unavoidable impacts due to improvements at Port Everglades meets all of these requirements.

#### **4.0 MITIGATION FOR UNAVOIDABLE IMPACTS TO SEAGRASS HABITATS**

##### **4.1 Determining Mitigation Needs for Seagrasses**

Seagrass mitigation requirements were determined using the State of Florida's Uniform Mitigation Assessment Method (UMAM) assessment. UMAM is a method used to determine mitigation needs based upon a number of quantitative and qualitative factors. UMAM has been used in other USACE-SAJ projects to help determine mitigation requirements, and its application in this project has been approved for "single-use" for this project by the USACE National Ecosystem Planning Center of Expertise (<http://el.erdc.usace.army.mil/ecocx/index.cfm>).

Due to the implementation of the LPP, a total of 7.41 acres of seagrass habitat (occupied and unoccupied) falls in the project footprint. Of that, a total of 4.01 acres of occupied seagrass habitat has been determined to require mitigation during the Feasibility Stage of the project. A pre-construction seagrass survey will be conducted prior to construction to determine the final acreage of occupied seagrass habitat that will be impacted and will require mitigation. UMAM calculations indicated that compensation of 2.483 seagrass functional units will offset that impact (Table 2) for the occupied habitat. All credible scientific information regarding the functional value of ephemeral seagrass habitat will be considered at that time to determine the amount of additional mitigation, if any. However, because mitigation construction has already been initiated by the local sponsor under the regulatory permit, revised UMAM calculations during the upcoming Preconstruction Engineering and Design (PED) phase of the project will likely indicate that fewer functional units will be required. This potential decrease is due to the time lag and risk factors (time to which mitigation reaches full function) in UMAM will be reduced or nearly eliminated by the time impacts occur due to the decrease in time lag due to the construction being conducted by the County prior to construction of the Feasibility Study project. Additionally, Broward County is working on a permit modification to slightly increase the amount of area to be used for seagrass creation as a contingency in case there are additional sea grasses above the already mapped 4.01 acres of occupied habitat. This modification will increase the available credits from 2.4 to 2.9 in West Lake Park.

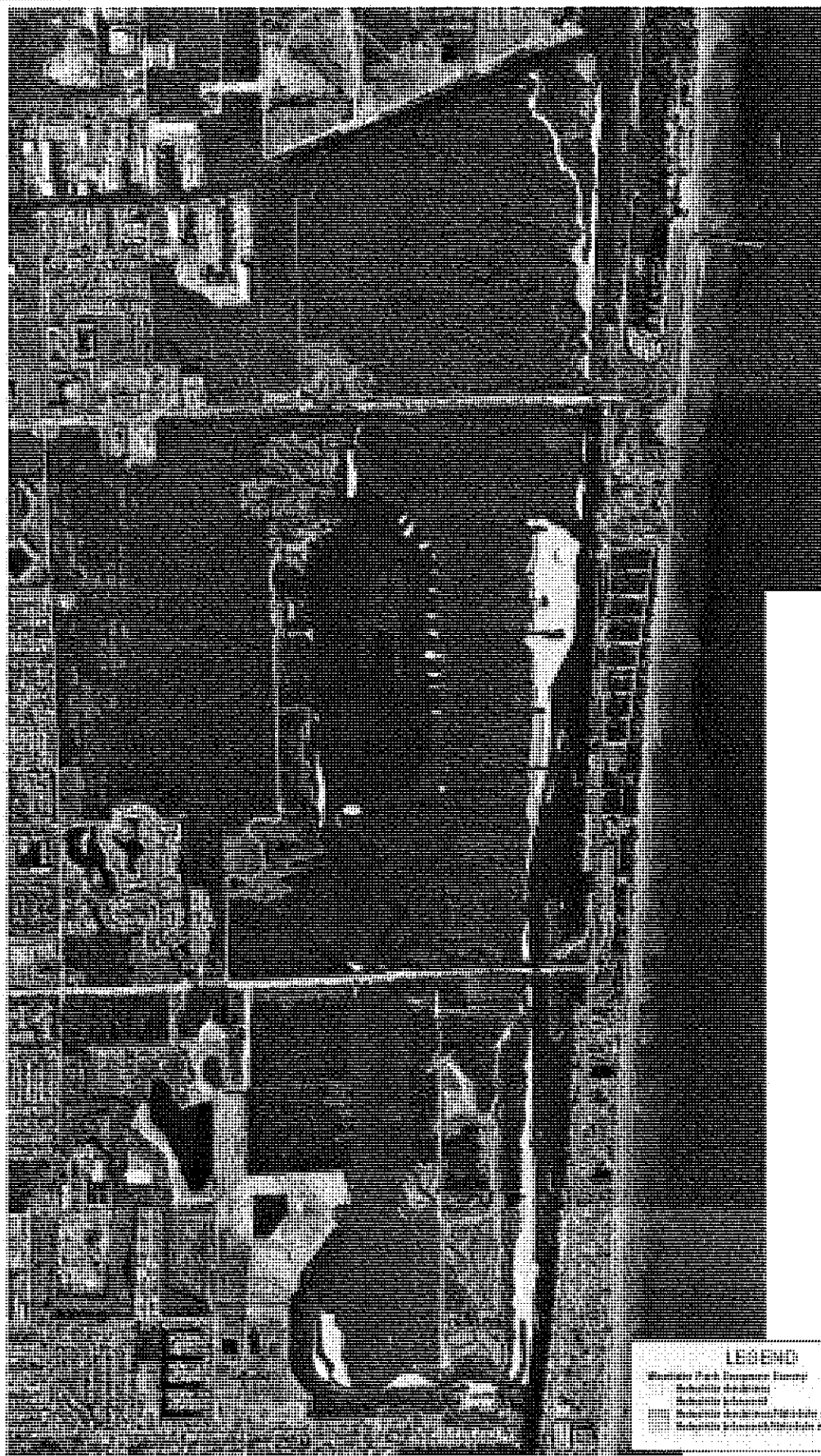
**Table 2 Uniform Mitigation Assessment Methodology Scores for Seagrass Habitats within Impact Area**

Impact Polygon	LS Before	LS After	WE Before	WE After	CS Before	CS After	Impact (ac)	Functional Loss
SHD-00818	6	0	6	0	3	0	0.018779	0.0093893
SHD-05641	6	0	6	0	3	0	0.129500	0.0647497
SHJ-77084	6	0	6	0	10	0	1.769605	1.2977104
SMX-01202	6	0	6	0	4	0	0.027594	0.0147168
SMX-00515	6	0	6	0	4	0	0.011823	0.0063054
SMX-02944	6	0	6	0	4	0	0.067585	0.0360453
SMX-00900	6	0	6	0	4	0	0.020661	0.0110192
SMX-02192	6	0	6	0	10	0	0.050321	0.0369023
WHD-08612	6	0	6	0	2	0	0.197704	0.0922620
WHD-00416	6	0	6	0	1	0	0.009550	0.0041383
WHJ-53469	6	0	6	0	3	0	1.227479	0.6137396
WHJ-06911	6	0	6	0	4	0	0.158655	0.0846158
WHJ-10206	6	0	6	0	4	0	0.234298	0.1249586
MHD-00037	6	0	6	0	1	0	0.000849	0.0003680
MHD-00039	6	0	6	0	1	0	0.000895	0.0003879
IHD-03618	6	0	6	0	2	0	0.083058	0.0387603
OEC grass	8	6	8	6	6	0	0.25	0.083
Total							4.26	2.483

Positions of polygons within the project area are shown in figures in Section 4.0 of the main text of the Environmental Impact Statement.

Key: LS: Landscape Support; WE: Water Environment; CS: Community Structure.

"Before"/"After" is relative to impact.



# LEGEND

- Shaded Park Boundary Lines
- Shaded Buildings
- Shaded Streets
- Shaded Parks/Plazas
- Shaded Streets/Highways

Shaded Buildings

0 100 200 300 400 500 Feet



Shaded Park Boundary Lines

Shaded Buildings  
Shaded Streets/Highways

Scale: 1" = 1000'  
Date: February, 1967

Drawn By: RHR  
Approved By:

**DALCOM**  
City of Los Angeles  
1000 Wilshire Blvd., Suite 1000  
Los Angeles, CA 90017

1967-1968  
Figure 2

**Table 3 Construction/ Initial Cost per Functional Unit of Seagrass Mitigation**

Seagrass Mitigation Alternative	Construction Cost of Mitigation	Benefits of Mitigation (functional units)	Cost/Functional Unit
WLP Seagrass Enhancements	\$9,596,466	1.0	\$3,864,876
Miami-Dade Seagrass Enhancements	\$12,929,000	1.0	\$5,298,770
Palm Beach Seagrass Enhancements	\$18,470,000	1.0	\$7,569,672

#### 4.3.4 Cost-Effective Seagrass Mitigation Plan

Cost estimates for the above three mitigation alternatives (West Lake Park, Miami-Dade County site, and Palm Beach County site) were calculated (as shown above), and those costs were used in an incremental cost analysis. It was determined through use of USACE Institute of Water Resources (IWR) software (IWR Planning Suite 1.0.11.0, certified 24 September 2008) that the West Lake Park habitat restoration alternative was the "Best Buy" alternative and that the other three alternatives were "Non Cost-Effective." Given that finding, the WLP alternative described above was selected as the proposed mitigation plan for impacts to seagrasses due to the implementation of the LPP.

#### 4.4 Proposed Mitigation Plan for Seagrasses

Unavoidable impacts to seagrasses will be mitigated by using credits (functional units) generated by habitat improvements at West Lake Park. The park land is owned by the State of Florida and leased by Broward County Parks and Recreation Division (BCPRD) on lands purchased under the CARL program. Liability for construction, monitoring and success for mitigation at West Lake Park rests solely with Broward County (the local sponsor). No real estate will be purchased by the USACE or the local sponsor. Access to the identified lands to perform the subject construction would be allowed via a right-of-entry for construction (minimum real estate interest sufficient to perform subject construction). The right-of-entry for construction is currently afforded to the local sponsor via an existing lease agreement executed in 1986 for a period of 50 years. Again, fee simple is not required, as the mitigation plan for this project consist only of the construction features as agreed to between the local sponsor and the State of Florida and USACE Regulatory Division. The mitigation plan "does not" have any monitoring or operation/management features. Due to the property being owned by the State of Florida and currently managed by the local sponsor (outside of the requirements for the civil works project), the value of the right-of-entry is essentially \$0.00.

The West Lake Master Plan (Miller-Legg 2003) was developed by BCPRD in consultation with Broward County's Port Everglades Department and the Broward County Aviation Department. The functional gains generated by the improvements have been approved (pursuant to county, state, and federal permits) to offset impacts due to projects constructed by various Broward County departments (among which are the Port and the Aviation Department, including Fort Lauderdale-Hollywood International Airport). Permits for WLP habitat improvements (see Appendix E-1) were issued by the South Florida Water Management District in April 2004, by the Broward County Environmental Protection Department in August 2004, and the USACE-SAJ Regulatory Division in March 2006. The WLP project was not permitted as a "mitigation bank." Therefore, there are no "credits" available for purchase by other public or private entities to offset impacts from other projects.

Submerged aquatic vegetation (SAV) restoration within WLP is also anticipated to occur as a result of enhanced flushing and circulation patterns along the southeastern region of the interior lagoon (Figure 2). As proposed, over 12 acres of flushing channels will be expanded or improved, or will benefit from the installation of culverts, resulting in improved water quality, clarity, and substrate conditions more suitable for seagrass propagation in the interior embayment (Miller Legg 2001b). Seagrass surveys conducted in West Lake serve to illustrate the benefits of flushing channels, as evidenced by the presence of seagrass beds near the mouth of each channel entering the lake (Miller Legg 2001c) (Figure 3). Based on observed changes in seagrass cover and existing seagrass bed occurrences it is anticipated that 40 to 60 acres of SAV, including *H. johnsonii* would be restored.

#### **4.5 Monitoring and Adaptive Management for Seagrass Mitigation**

The West Lake Park plan (as proposed by Broward County and permitted by the State of Florida and USACE Regulatory Division) describes the mitigation monitoring as follows:

A time-zero monitoring event will be performed, and then the seagrass recruitment area shall be monitored quarterly for the required five-year period. Forty paired, one-square meter quadrats will be randomly placed within the created seagrass habitat during each monitoring event. Distribution of the 40 quadrats will be divided equitably between the seven seagrass creation areas. Random, rather than fixed, quadrats will be used so that the results are without bias and can be used to accurately generalize over the entire area (Fonseca, personal communication). Random directions and distances will be chosen using a random number generator. The random direction and distance will be from the approximate center of each seagrass creation area. An equal number of replicate quadrats will be established in the adjacent, surrounding, seagrass beds (at least 50' from the creation areas) to serve as a control. The following data will be collected at each quadrat:

- Relative water depth
- Time
- Species present
- Shoot counts
- Aerial coverage by photo-documentation
- Qualitative observations of natural seagrass recruitment and vegetative expansion of planting units

In addition to the above-listed data, the following data may also be collected for each monitoring event: tides, weather, water temperature, and wind. A staff gauge or piezometer shall be installed to record tide level.

Survivorship rates may be assessed based on measurements within the paired 1 m<sup>2</sup> quadrats. Abundance measurements shall be made through visual and photographic assessments of percent aerial coverage by species. The 1 m<sup>2</sup> quadrat shall be divided into 10 cm x 10 cm grid and the number of squares containing seagrasses shall be counted to estimate cover.

In addition, percent aerial coverage will be equated to Cover Classes, based on the Braun-Blanquet technique, as follows:

**Table 6 - Mitigation Costs with Adaptive Management Added**

Seagrass Alternative	Construction Cost of Mitigation	Monitoring and Adaptive Management Costs	Total Costs
WLP Seagrass Enhancements	\$9,596,488	\$114,700	\$9,827,866

## 5.0 MITIGATION FOR UNAVOIDABLE IMPACTS TO MANGROVE WETLANDS

### 5.1 Determining Mitigation Needs for Mangrove Wetlands

Mangrove mitigation requirements were determined using the state of Florida's Uniform Mitigation Assessment Method (UMAM) assessment. UMAM is a method used to determine mitigation needs based upon a number of quantitative and qualitative factors. UMAM has been used in other USACE-SAJ projects to help determine mitigation requirements, and its application in this project has been approved for "single-use" for this project by the USACE National Ecosystem Planning Center of Expertise.

Due to the implementation of the LPP, 1.16 acres of mangroves will be impacted. UMAM calculations indicated that compensation of one (1) wetland functional unit will offset that impact (only 0.87 unit is required as indicated in Table 6 below). However, because mitigation construction has already been initiated, revised UMAM calculations during the upcoming Preconstruction Engineering and Design (PED) phase of the project will likely indicate that fewer functional units will be required. This is because the time lag factor (time to which mitigation reaches full function) in UMAM will be reduced or nearly eliminated by the time impacts occur.

**Table 7 Uniform Mitigation Assessment Methodology Scores for Mangrove Habitats Within Proposed Impact Areas**

			Location & landscape support		Water environment		Vegetation structure		Resulting calculated change (functional units)
EWRAP Zone	Acres	Location	without impact	with impact	without impact	with impact	without impact	with impact	
0.70	0.08	SAC	6	0	7	0	5	0	-0.05
0.70	0.34	SAC	6	0	7	0	5	0	-0.20
0.70	0.13	SAC	6	0	7	0	5	0	-0.08
1.00	0.18	SAC	8	0	8	0	9	0	-0.15
1.00	0.23	SAC	8	0	8	0	9	0	-0.19
1.00	0.00	SAC	8	0	8	0	9	0	0.00
0.97	0.01	SAC	6	0	7	0	9	0	-0.01
0.97	0.26	SAC	6	0	7	0	9	0	-0.19
0.97	0.00	SAC	6	0	7	0	9	0	0.00
Cumulative change in functional value of mangroves in impact area due to project:									-0.87

Note: Data based on interagency meeting, June 2005 Key: SAC = Southport Access Channel.

fewer functional units are likely to be necessary for use (due to a decreased time lag factor) as discussed in Section 5.1.

**Table 8 Construction/ Initial Cost per Functional Unit of Mangrove Mitigation**

Mangrove Mitigation Alternative	Construction Cost of Mitigation	Benefits of Mitigation (functional units)	Cost/Functional Unit
WLP Mangrove Enhancements	\$1,416,249	1.0	\$1,416,249

#### 5.3.4 Cost-Effective Mangrove Wetland Mitigation Plan

An alternative is considered cost effective if no other alternative provides the same level of output for less cost, and if no other plan provides more output for the same or less cost (ER 1105-2-100). The table above shows the comparison of plans. However, as only one alternative plan is proposed, that plan is the cost-effective mangrove mitigation plan.

#### 5.4 Proposed Mitigation Plan for Mangrove Wetlands

Unavoidable impacts to mangrove wetlands will be mitigated by using credits (functional units) generated by habitat improvements at West Lake Park. Section 4.4 of this document provides an overview of West Lake Park. The park land is owned by the State of Florida and leased by Broward County Parks and Recreation Division (BCPRD). Liability for construction, monitoring and success for mitigation at West Lake Park rests solely with Broward County (the local sponsor). No real estate will be purchased by the USACE or the local sponsor. Access to the identified lands to perform the subject construction would be allowed via a right-of-entry for construction (minimum real estate interest sufficient to perform subject construction). The right-of-entry for construction is currently afforded to the local sponsor via an existing lease agreement executed in 1986 for a period of 50 years. Again, fee simple is not required, as the mitigation plan for this project consist only of the construction features as agreed to between the local sponsor and the State of Florida and USACE Regulatory Division. The mitigation plan "does not" have any monitoring or operation/management features. Due to the property being owned by the State of Florida and currently managed by the local sponsor (outside of the requirements for the civil works project), the value of the right-of-entry is essentially \$0.00.

The ecological value of improvements, which will be gained through the WLP project, was assigned via use of State of Florida's Uniform Mitigation Assessment Methodology (UMAM), as is standard practice for Clean Water Act (CWA) Section 404 and Section 401 permitting in the state. As proposed, the WLP plan would include the creation (24.2 acres), enhancement (40.4 acres), and preservation (23.3 acres) of mangrove wetlands, and other improvements to various estuarine resources (Table 4). These activities will result in the accumulation of approximately 38 mangrove wetland functional units, in accordance with permit conditions, for use as mitigation for only Broward County projects.

As noted above in Section 5.1, based on UMAM calculations, USACE Regulatory Division will require one (1) of the 38 WLP mangrove functional units to compensate for the 1.16 acres of mangroves that will be impacted due to the implementation of the LPP.

Principal among the actions for creating mangrove habitat is the grading of existing spoil islands to the appropriate depth (between approximately elevation -0.3 feet, or MLW, and elevation 1.7 feet, or MHW). These new habitats will be located along the Intracoastal Waterway (IWW), as indicated by

**Table 9 - Mitigation Costs with Adaptive Management Added**

Mangrove Alternative	Construction Cost of Mitigation	Monitoring and Adaptive Management Costs	Total Costs
WLP Mangrove Enhancements	\$1,416,249	\$40,300	\$1,496,849

## 6.0 MITIGATION FOR UNAVOIDABLE IMPACTS TO HARDBOTTOM HABITATS

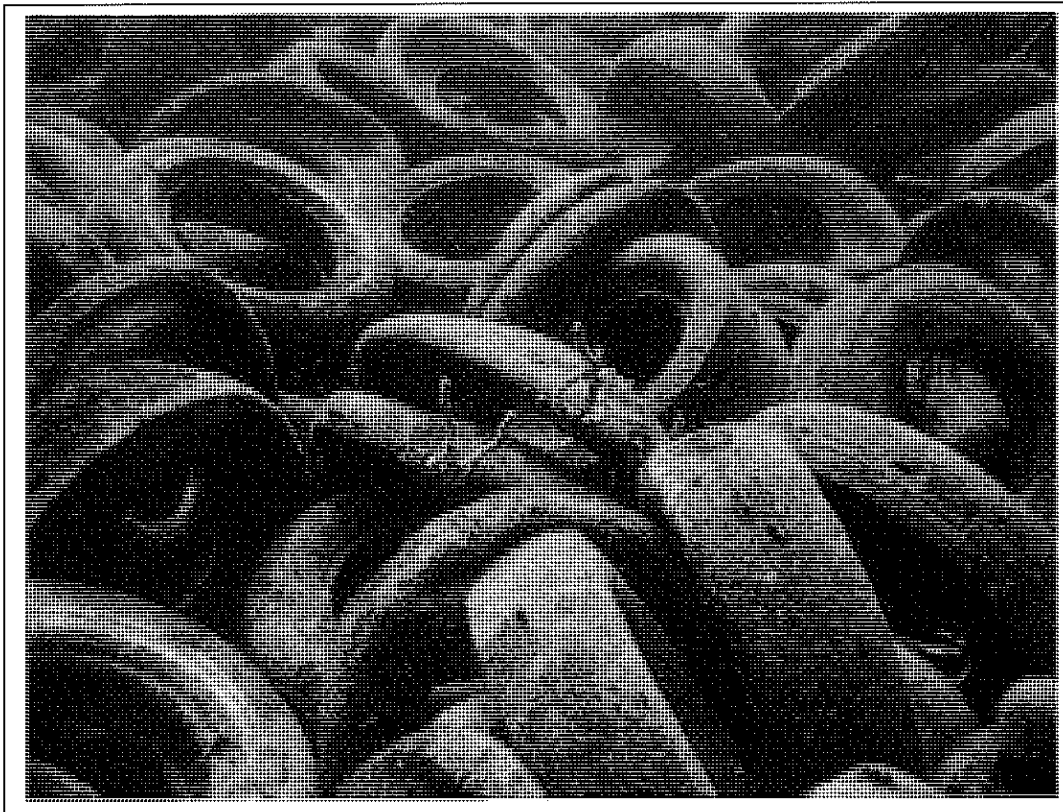
### 6.1 Determining Mitigation Needs for Hardbottom Habitats

A Habitat Equivalency Analysis (HEA) takes into account the quantification of ecological services lost from an impact as well as the interval of time necessary for habitats (those either impacted or those proposed for mitigation) to reach optimum performance. Hence, it can be used to determine the appropriate quantity of compensatory mitigation (King 1997). HEA has been used in other USACE-SAJ projects, and its application in this project has been approved for single-use in this project by the USACE National Ecosystem Planning Center of Expertise.

The HEA method (as detailed in NOAA 2000) was used to calculate mitigation requirements (in acres) for reef and hardbottom impacts associated with the proposed project (see DC&A and USACE 2014; i.e., Appendix E-2). The HEA took into account both anticipated impact acreages for various habitats (inner, middle, and outer reefs, as well as channel wall impacts and indirect impacts (see DC&A and USACE 2013 for details) and recovery times to calculate the overall loss of habitat function that occurs from the time a new impact occurs to the time of full functional recovery. Projected impact acreages were classified according to the various relief/profiles and habitat types in the affected areas. Therefore, in effect, several HEAs were conducted, and then resulting acreage assessments combined to arrive at the total mitigation acreage required. The results of the analysis are provided in DC&A and USACE (2014; i.e., Appendix E-2), which details the assumptions (form of recovery function, relative functionality at time "0" and at the end of recovery period, interval of recovery period for each habitat type impacted, etc.) that were used in the analyses. Finally, for performance of an HEA, assumptions concerning mitigation measures must be provided. Due to previous experience with similar projects in southeast Florida, USACE assumed that artificial reef construction using quarried or dredged rock would be the most likely and feasible mitigation, so that was selected as the candidate mitigation for which output data would be configured.

For the HEA runs, the potential direct impacts were broken into three direct impact components and the indirect impact component. There are three potential direct/incidental impact components. Depending on dredging methodology(ies) chosen by the selected contractor, all three of these Components may occur, or some combination of the three may occur. For a description of each Component, please review Section 4.5.1 of the "Mitigation Requirements Analysis for Hardbottom Resources Associated with Port Everglades Harbor Navigation Improvements". Table 8 below details the impacts associated with each Component and the required mitigation Serve Acre Years (SAYs) for each of the Components. In addition to these impacts hardbottom habitats surrounding the would-be new channel limits (up to 150 meters away) that may be affected by sedimentation and/or turbidity. The indirect effects associated with sedimentation/turbidity are included below. Finally, to complete the HEA, a candidate mitigation scenario must be assessed, using its estimated value (and time required to reach its optimal functionality) in calculations. The candidate mitigation project subjected to evaluation was construction of artificial reef including installation of coral colonies. For this mitigation alternative, the mitigation requirement is the creation of hardbottom habitat through construction of artificial reef structures and outplanting of corals propagated in nurseries into degraded habitats in Broward County. The above-described analysis relates only to

tires (Figure 4). The tires also did not perform as estimated from a marine life colonization standpoint. The tires are now mobile in the marine environment, and during storms, they wash into the seaward side of the middle reef causing ongoing habitat degradation. Since 2001, a variety of efforts has been made to remove the tires including projects conducted by NOVA University and Broward County, in concert with the US Army and US Navy divers. It is a time-consuming effort that must be carried out by divers, as mechanical equipment would risk damage to the reefs adjacent to the tire field. The previous efforts were funded through Coastal America Grants, and the project has received a Coastal America Award. However, there are still approximately 700,000 tires remaining to be recovered and funding remains a significant limitation to project implementation (K Banks, BCEPD, pers. comm. 2012). This alternative was removed from further consideration because to gain any ecological function of the benthic habitat, nearly all the tires would have to be removed (any remaining tires could drift to other areas and damage reefs). In addition, the resulting functional gains that could be provided would be less than many of the other available mitigation options. Furthermore, the minimal gains would come at a much higher cost than many other options.

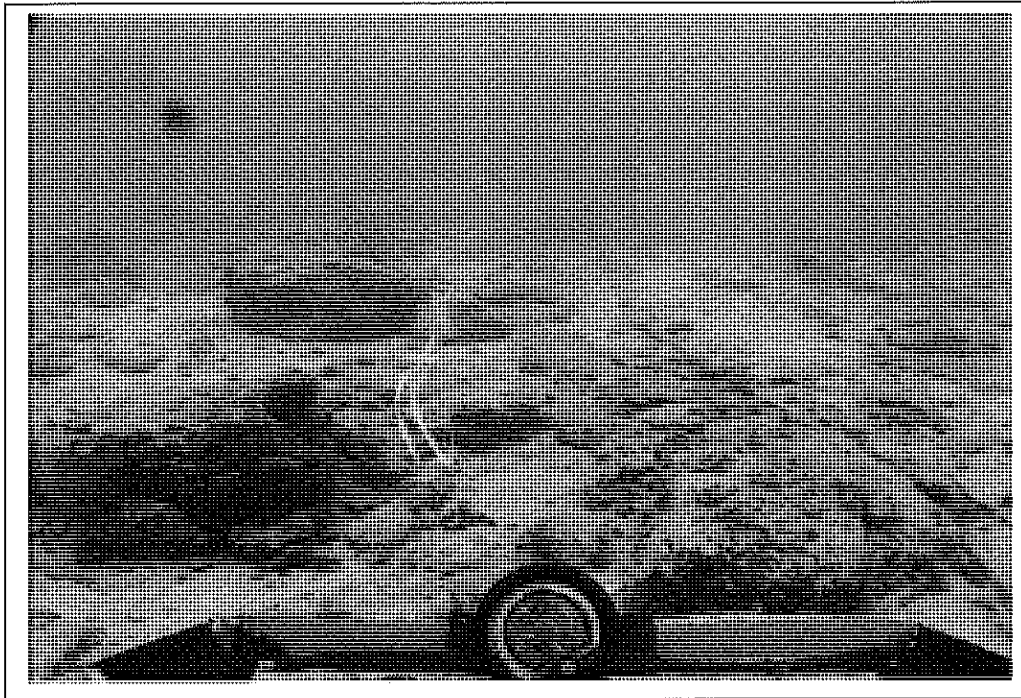


**Figure 4 Ocean Floor Covered with Tires: "Osborne tire-reef"**

## **2. Artificial reef placement on tire "reef"**

Broward County proposed for use as mitigation the placement of artificial reef materials on top of the Osborne Tire Reef (discussed above) to stabilize the tires and prevent them from continuing to move shoreward and impact the middle reef. In theory, the materials would prevent middle-reef damage as well as provide usable hardbottom substrates for reef species colonization. The proposed plan involves the use of limestone boulders, placed over the "tire reef" stabilized with a tremie pour of

results of the survey indicated this area supports some of the highest hard coral densities on the third reef and similar soft coral densities and numbers of species as the impact site (DC&A 2009), which may mean, that although it is “previously impacted”, it is not in need of enhancement. Based on that assessment, it was determined that this was *not* a viable option for mitigation for the Port Everglades project.

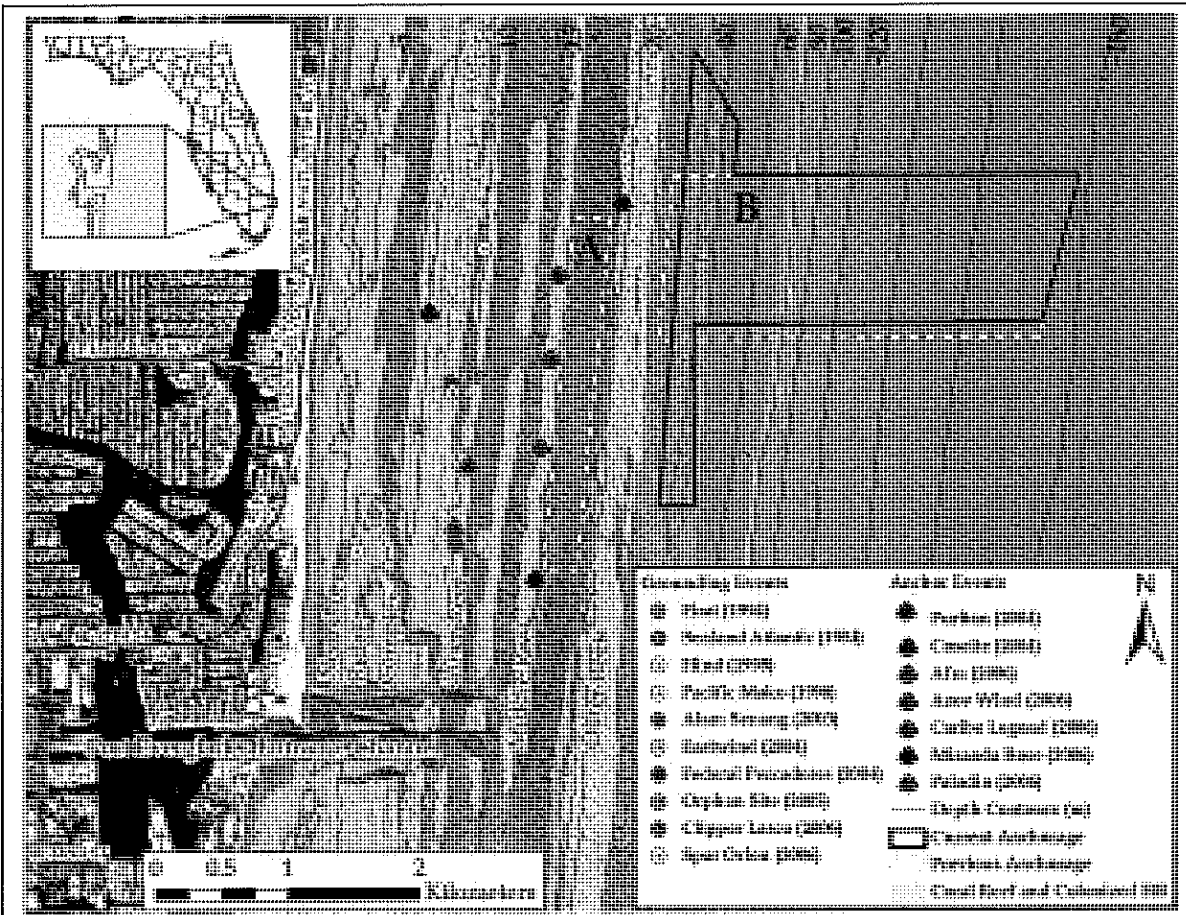


**Figure 5 Previously Impacted Area on Outer Reef, South of the Planned OEC Expansion**

#### 5. Reef research

During PERG meetings, one or more participants inquired whether some mitigation funds could be used to perform research on reefs, or even just to construct artificial reefs with various materials or in various configurations such that research could be performed, even as the reefs provided targeted ecological functions. This would be considered “value-added” mitigation, where a secondary purpose could be achieved that may have indirect benefits for reef system design in years to come.

USACE mitigation policy requires that mitigation replace lost habitat function and that the success of the mitigation be measureable using success criteria. Although installation of artificial reefs meets this requirement, research does not specifically and directly replace lost habitat function, although the results of research may help resource managers to better assess impacts and create viable habitats for future projects. However, because the functional ecological benefits for the part of this alternative relating to research cannot be directly quantified, this alternative was determined to not be a viable option for mitigation for the Port Everglades project.



**Figure 6 Location of Groundings Offshore of Port Everglades (Gilliam and Moulding 2012)**

7. Removal of previous dredged materials from habitat north of the channel

In the nearshore ridge complex, adjacent to the north edge of the existing channel is an area where dredged material had been side-cast for a 1962 Port expansion project (Figure 7). For this mitigation alternative, the deposited material would be removed to expose hardbottom substrates and/or rock would be installed in these areas to facilitate colonization. Other than a study conducted on the western-most portion of the previously dredged material, there is little known information available about the on-site conditions and whether this could be developed into a viable mitigation alternative. Additional studies would be necessary to determine feasibility. For that reason this mitigation alternative was removed from further consideration.

This plan involves the deployment of piles of limestone that have been either quarried and transported to the mitigation area, or dredged from the channel construction areas. The piles will be configured into rows that are parallel to the existing reef tracts. Two layers of boulders will comprise these piles, given a vertical dimension of approximately 6 to 8 feet of relief. Low relief areas will comprise only one layer of boulders. Similar structures will be constructed near the Port of Miami in 2013. Based on outcomes from that effort, USACE will be able to improve on design and materials specifications for Port Everglades mitigation.

The interval required to reach substantial functional productivity of this alternative is estimated to be 30-50 years. As proposed, coral colonies greater than 10 cm (up to 11,502 colonies) in diameter and free of disease and boring sponge would be transplanted from the impact area to the mitigation sites, which would be prepared in advance of dredging.

Drawbacks to this alternative are that the artificial reefs, as proposed above, are not as aesthetically pleasing as adjacent natural hard-bottom reef structures, they do not include a tremie concrete pour that would bond them even more securely to the seafloor, and they would remove some softbottom (sand) habitats adjacent to existing reefs when the rock is placed on the sand. Finally, just after completion of installation, the functional value of the reefs is relatively low (compared to restored/enhanced reefs or boulders to which corals have been transplanted). Additional details regarding this alternative are found below.

#### 9. Artificial reef creation using modular materials

Creation of artificial reefs using modular materials instead of quarried or dredged rock is another alternative. This alternative is identical to the Reef Creation alternative discussed above, but for the use of modular reef materials. This alternative utilizes modular reef components that are created on-shore and moved to the reef placement site. Modular reef habitat construction as a compensatory restoration alternative would consist of using established technology to construct and place cement reef-replication modules in a manner to provide a range of desirable ecological services. For example, a modular reef can be designed to maximize vertical profile, surface area for settling organisms, crevices for shelter, foraging habitat for pelagic organisms, or some combination of services such as these. Prefabricated reef modules have been used in the United States (including Broward County) to restore coral reefs impacted by vessel groundings and deployment of telecommunication cables. The creation of an artificial reef that mimics low relief hard-bottom coral reef can be designed for both aesthetics and habitat function. The project to construct and place cement reef-replication modules in a shallow or deep hard-bottom environment could be located in one or more favorable settings north or south of the project footprint. Another benefit is that upon installation, they have a moderate (vs. low, as in the rock reef creation alternative) functional value.

Costs for this alternative are relatively higher due to (1) on-shore labor to create the modules, (2) land-based, as well as sea-based, transportation costs, and (3) diver labor necessary to place the modules on the seafloor. However, the benefits include ease of construction and their secure placement on the seafloor.

The interval required to reach substantial functional productivity of this alternative is estimated to be 30-50 years. Coral colonies greater than 10 cm (up to 11,502 colonies) in diameter and free of disease and boring sponge would be transplanted.

natural coral reproduction; larval transport; settling and colonization into new areas; and genetic mixing required for survival and recovery of the species. Furthermore, this proposal is consistent with the NMFS Acropora Recovery Strategy (under development) and other coral recovery plans for coral species that may be listed under the Endangered Species Act. The entire draft proposal for this alternative is located in Appendix E-4.

#### 11. Blending of components from various mitigation alternatives (Preferred Mitigation Option)

This alternative is a hybrid of the USACE preferred plan (alternative 8 - artificial reef creation using quarried or dredged rock), and NOAA's preferred plan (alternative 10 - coral propagation and active species enhancement), and portions of 6 (repair of grounding sites and subsequent coral installation).

Under this hybrid plan, at least five (5) acres of boulder-based artificial reef would be constructed. Approximately 2.03 acres would receive coral transplants that have been relocated from dredging impact areas and transplanted to boulders at a density commensurate with the impacts (1.4 corals/m<sup>2</sup>). In addition, 2.97 acres of boulder-based artificial reef would be constructed without coral transplants.

The remaining mitigation would be in the form of direct enhancement of partially degraded reef sites proximate to, but not directly in or adjacent to the impacts associated with the Port Everglades project. The proposed reef mitigation project would enhance degraded reefs by outplanting regionally appropriate corals and sponges at a density and in numbers commensurate with those impacted. The organisms for outplanting would be sourced from corals and sponges of opportunity or propagated in ocean-based or land-based coral nurseries operated under contract associated with the project for a period of 11 years. Contract award will be through the RFP process.

The coral propagation contractor shall be required to monitor the outplanted propagated corals for a 3-year period for each outplanting area. After 3-years of monitoring of each outplanting area, the final determination of success for that outplanting area will be made and that area will no longer be monitored.

Outplanted nursery corals shall be monitored for survival and Adaptive Measurement Measures shall be taken to ensure survival remains above 80% based on the Monitoring and Adaptive Management plan found in Appendix E-5 of the Monitoring plan. Survival shall be compared to control sites with similar species composition as the outplant sites to detect any region-wide changes or stochastic events like disease or a hurricane. The project shall reflect similar coral survival as the control sites for the outplanted species. Control sites shall be selected by the contractor, reviewed by the Corps and the Adaptive Management Committee and approved by the Contracting Officer.

Based on HEA, the total number of outplants was determined to be 103,191 corals. This does not include up to a 20% contingency. These supplemented corals would improve local reef structure and function. More importantly, the outplanted corals would increase the likelihood of successful sexual reproduction and contribute directly to the pool of coral larvae available to colonize adjacent reefs. In order to maximize the return of lost services, the agencies propose to outplant a regionally appropriate mix of both fast and slow growing massive, branching, and octocorals as well as habitat forming sponges as part of the mitigation project.

### 6.3 Incremental Cost Analysis Results for Hardbottom Habitat Mitigation Alternatives

#### 6.3.1 Expected Cost of Alternative Hardbottom Habitat Mitigation Plans

### 6.3.3 Construction/ Initial Cost per Hardbottom Habitat Functional Unit

The base-year cost of each alternative mitigation plan is compared to the respective benefit (functional unit, or acre) below (see Table 12). Costs are based on FY2012 estimates (annualized values are provided in the Economic Appendix of the Feasibility Study). Artificial reef creation costs were determined from a review of actual contract award costs for the Florida Keys National Marine Sanctuary as well as the Port of Miami artificial reef construction projects. Some commenters have offered that the Corps' costs are too low, however they are based on a review of many recently awarded contracts for large scale, deep water reef restoration and coral relocation. Costs per acre for the five mitigation alternatives ranged from approximately \$1 million to \$1.5 million. Coral propagation costs were determined by an industry survey conducted by NOAA and provided to USACE.

**Table 12 Construction/ Initial Cost per Acre of Hardbottom Mitigation**

Reef Mitigation Alternative	Construction Cost of Mitigation	Benefits of Mitigation (acres)	Cost/Acre
Grounding Restoration Sites	\$25,089,120	19.912	\$1,260,000
Artificial Reef Creation- Modules	\$71,932,416	48.325	\$1,488,514
Tire Field Stabilization w Art. Reef Creation	\$67,341,541	48.325	\$1,393,514
Artificial Reef Creation- Boulders	\$55,7229,004	48.325	\$1,153,213
Artificial Reef and outplant of nursery corals	\$23,747,202	23.21 (5 artificial/ 18.21 enhancement)	\$1,023,145

#### 6.3.4 Cost-Effective Hardbottom Habitat Mitigation Plan

Cost estimates for the above alternatives that were determined to be practicable (reef creation with coral outplants; reef creation on tire debris field, reef restoration in former anchorage area, and reef creation, including the modular-reef option) were calculated, and those costs were used in an incremental cost analysis. An alternative is considered cost effective if no other alternative provides the same level of output for less cost, and if no other plan provides more output for the same or less cost (ER 1105-2-100). The table above shows a comparison of plans. The reef creation with nursery corals is not only the least cost alternative, but it also has the lowest cost per increment. Given that finding, the "reef creation with coral outplants" alternative described above was selected as the proposed mitigation plan for impacts to hardbottom habitats due to the LPP.

#### 6.3.5 Hardbottom Habitat Mitigation Cost Based on Selected OEC Depth Option

Several alternative authorized depths are under consideration for the LPP's Outer Entrance Channel element. These authorized depths result in actual depths ranging from 55 to 59 feet (one-foot increments; "authorized" or "project" depths are seven feet less than these depths). Each depth would affect/impact a different amount of hardbottom habitat. The following table (Table 13) shows what those differences are (in acres) and lists the different mitigation requirements and costs for each depth under consideration, based on the Best Buy mitigation alternative noted above.

of the natural reefs as much as possible. Biological connectivity also relates to potential exposure of artificial reef structures to pelagic larvae, such as might be carried by the Gulf Stream.

Mitigation reefs have often been required to be built in the immediate vicinity of the natural reefs impacted by construction activities. In areas where the habitat that was impacted was the only habitat in the area, this approach has merit. A guiding principle of artificial reef development has always been that reefs should not be deployed immediately adjacent to productive reef habitats. From a fisheries standpoint, reefs placed in non-reef habitats are biologically more productive as they are trophically coupled with foraging habitats that are unexploited by other reef fishes (Bortone 1998). More importantly, the shifting of reef materials in storms may severely damage adjacent natural habitats. For this reason, the Florida Artificial Reef Development Plan prohibits material from being placed within 100 yards of "live bottom" areas, such as nearshore hardbottom (Myatt and Myatt 1992). Following Hurricanes Andrew, Opal, and Erin, it was found that even massive materials in relatively deep water were moved or broken up by tremendous wave forces (Lin 1998, Turpin 1998). The possibility exists that less massive materials in much shallower water could shift and damage adjacent natural habitats. For the above reasons, sites selected for mitigation reef construction should have no significant areas of natural reef within 100 yards and no reefs should be placed directly seaward and immediately adjacent of any significant area of natural reef.

#### 6.4.2 Location, Materials, and Design

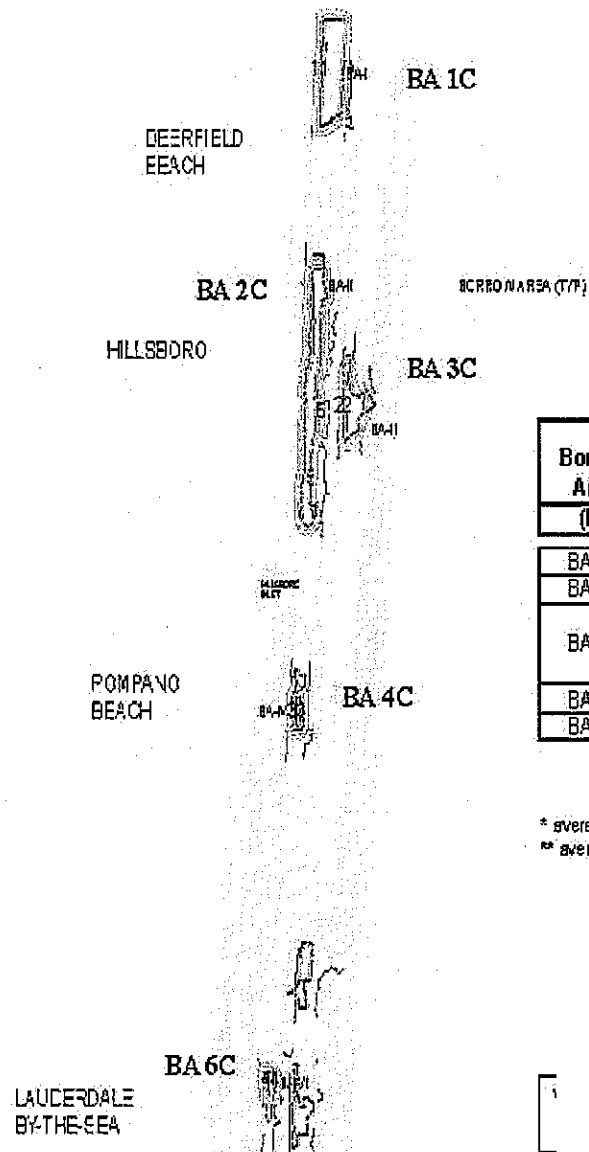
Mitigation reefs will be designed and placed to mimic the impacted natural habitat of the middle and outer reefs. Two types of mitigation reefs will be constructed: High Relief, High Complexity (HRHC) reefs (exceeding three feet of vertical relief) and Low Relief, Low Complexity (LRLC) reefs (approximately three feet of relief). The HRHC reefs are intended to mitigate for impacts to high relief habitat (i.e., linear or spur-and-groove reefs) and the LRLC reefs are intended to mitigate for impacts to lower relief reef (i.e., pavement or channel wall) and hardbottoms outside of the project footprint (i.e., in the indirect effect area). The two reef types will be deployed in acreages proportional to direct impacts expected to each type of natural reef habitat (where impact habitat types were based on data collected in 2006 (DC&A 2009) and published classification systems): 31% of the artificial reef will be LRLC and 69% will be HRHC.

Several areas are under investigation to serve as sites for installation of artificial reefs (Figure 8). The Corps hopes to partner with Broward County to identify the best location for placement of the five acres of artificial reef. Geotechnical investigations and other reconnaissance (including environmental) will be necessary to determine precisely the best position(s) for reef structures to be installed. Appropriate members of Broward County, FWS, NMFS, FWC, EPA and DEP staffs will be consulted prior to final siting.

Limestone rock excavated from the STB, MTB, IEC, and the OEC may be used in reef construction and, if necessary, supplemented with quarried limestone. If the selected contractor chooses to use project-produced rock, they may commence excavation *inside* the harbor, transporting the material offshore for mitigation construction, and then proceed to dredging the entrance channel; i.e., dredging and reef installation will occur simultaneously. Alternatively, the construction contractor will be allowed the option of purchasing quarried native limestone in lieu of using the material from within the project boundaries. Contract specifications/requirements may be stated in the following manner, as they were for another recent federal project in South Florida:

"The sites [i.e., dredge sites/project components] may be used in any combination to provide the minimum area for both low-relief and high-relief reef and may be used in their entirety if desired. Suitable materials for use in the reef mitigation areas shall consist of rock excavated from the project or native limestone quarried from Palm Beach, Broward, Dade, Monroe,

## PORT EVERGLADES BORROW AREAS FOR REEF MITIGATION



Borrow Area (ID)	Acreage (acres)		Av. Widths*	AV. Depths**	Depth Range (ft)	Distance from center of Borrow Pit to Channel Entrance	
						(ft)	(miles)
BA 1C	112		1000	36	35-48	81250	15.39
BA 2C	224		600	35	30-45	67800	12.84
BA 3C	78	top	150	40	36-45	67400	12.77
		mid	1050				
		bot	430				
BA 4C	46		300	40	36-47	53800	10.19
BA 6C	36		400	40	35-45	38500	7.29

\* average widths obtained from GIS mapping tool

\*\* average depths obtained using borrow area post dredge survey maps and GIS mapping tool

**Figure 8 Proposed Artificial Reef Installation Sites, Broward County**

essential component of the reef mitigation, replacing the three-dimensional structure of the reef is also important. *Acropora cervicornis*, in addition to barrel sponges and other reef species being considered, will provide significant three-dimensional structure through their normal growth patterns. *Acropora cervicornis*, with its fast growth rates, will provide three-dimensional structure more quickly than other species.

Offshore nurseries will be sited in a manner so as to balance a number of factors including, among others, appropriate habitat and water quality conditions, potential for future impacts, and permitting. Once coral fragments have grown to a size where the probability of survival on natural reef has increased to an acceptable level (this usually requires 12 to 18 months), the corals are outplanted to the natural reef. The decision on which species to propagate and outplant in addition to staghorn coral (*Acropora cervicornis*) and the balance among all species would be based on the state of the science at the time the project is funded. Additionally, outplant sites would be selected using a strategy that maximizes likelihood of outplant survival while minimizing risk from natural and human disturbances.

Using a Habitat Equivalency Analysis, it is estimated that 103,191 initially surviving corals need to be successfully outplanted from nurseries to offset the impacts to coral from expanding the Port Everglades Outer Entrance Channel. Additionally corals will need to be rescued, propagated, and outplanted to meet this target. Importantly, the 103,191 outplants is the initial outplanting requirement and does not include additional corals that may be needed as part of an adaptive management program to meet performance objectives (estimated currently at 20%). Over time as we learn from the adaptive management program, it is possible the amount of outplants could be reduced. The outplant species mix is expected to be a regionally appropriate species mix comprised of a relatively even distribution of fast and slower growing organisms.

#### 6.4.4 Location, Materials, Design (*NMFS – NEPA Cooperating Agency*)

While not a requirement, partnerships with the entities that created the existing ocean-based nurseries would result in project implementation efficiencies and these partnerships need to be formalized. The location of the ocean-based nurseries can include expanding existing nursery sites on land and offshore Broward County which have been implemented by Nova Southeastern University, in addition to the creation of new ocean-based nurseries. Ideally, the ocean based nurseries would be separated by distances sufficient to absorb a localized impact (e.g., anchor drag, disease outbreak, weather event). The inclusion of the land-based operations would also help minimize the impacts from damage to offshore sites. During the ramp-up phase, new offshore nursery sites will be tested and established. The fieldwork associated with the exploration of new nursery sites will also be expanded in scope to include the examination of future suitable outplant sites.

There is value in the nurseries being designed to include a variety of designs (e.g., growout trees, lines, platforms). For example, while the use of lines may allow the fastest coral growth, this design may also be the most susceptible to impacts from storm damage. The state of the science at the time of project implementation, will inform the nursery design.

The coral propagation and outplanting project will require numerous sites that sum to approximately 18 acres. Selection of these sites will be done in coordination resource agencies and partners after the Port Everglades feasibility study is approved by Congress and funds are appropriated for detailed engineering design. Table 14 includes site selection criteria based on Johnson *et al.* (2011), which are guided by the distribution and status of natural reefs.

typical relief of the reef has been significantly reduced by subsidence, scour, or sand accretion, additional materials will be added as necessary to restore the reef to the as-built design.

A study design consisting of standard underwater assessment methods will be used in order to statistically compare mitigation reefs to natural reefs (control sites). Success criteria for benthic algae, invertebrates and fish populations will be established in order to demonstrate mitigation success. Success criteria will be based on the biological communities of control sites (natural reefs) and may include species richness, density, and cover of benthic algae, invertebrates, and fishes. Standard methods used to assess these parameters may include, but are not limited to in situ and/or video transect data collection for assessing benthic algae and invertebrate populations; in situ or photo-quadrat data collection for benthic algae and invertebrates; cylinder fish population surveys and/or roving diver fish surveys. Appropriate parametric and non-parametric statistics shall be employed in order to demonstrate mitigation success criteria are met. An example of one possible biological sampling protocol is described below:

Five randomly selected locations on each type of mitigation reef will be chosen and benchmarked for permanent photo-quadrat stations to assess sessile invertebrate and algae abundance. Randomly selected stations on high and low relief natural hardbottom reefs will also be established to serve as controls. Locations for ½-square-meter photo-quadrats will be established by driving two steel pins into the reef that will precisely locate the quadrat frame. The sites will be benchmarked using a DGPS system with sub-meter accuracy. Invertebrate and algal abundance will be evaluated from digital photography of each quadrat. Species will be identified to the lowest practical taxon and ranked in order of abundance. Superimposing a grid over the digital image and counting bare and colonized grid squares will assess overall percent cover (Bohnsack 1979). Criteria for success of the mitigation reef will be based upon a comparison of a total percent cover of algae and invertebrates at the new reefs and at control reefs of corresponding relief type. The criteria for success of the mitigation reefs in establishing a similar community structure will be a finding of no significant difference in the rank abundance orders of species between mitigation and control reefs of each type. Statistical comparisons between mitigation and control reefs will be made using the Wilcoxon Rank-Sum (Zar 1984) or similar nonparametric test at  $p=0.05$ .

Fish population evaluations will be based on visual censuses conducted separately on HRHC and LRLC mitigation reefs and high and low relief control reefs. The point-count method (Bohnsack and Bannerot 1986) will be used for fish assessment. This method has the advantage of gathering quantitative data in a relatively short time in a very repeatable pattern that is relatively insensitive to differences in habitat structure. Each census will have a duration of five minutes and a radius (the distance from the stationary observer) of 10 feet. Ten censuses will be collected on each of the four reef types. Data from these types of censuses is rarely normally distributed, so the Wilcoxon Rank-Sum or a similar nonparametric test will be used for significance testing. The criteria for mitigation reef success will be a finding of no significant difference at  $p=0.05$  between reef type pairs (HRHC vs. high relief control and LRLC vs. low relief control).

Results of all mitigation reef monitoring efforts will be summarized in an annual report to be completed by December 31 of each year the monitoring program is in place (i.e., until success criteria are met). Copies of the report will be distributed to all agencies and interested parties. Data from monitoring events will be reviewed by USACE staff in consultation with other federal and state agencies to guide decisions on necessary operational or structural changes (adaptive management)

**Table 15 - Mitigation Costs with Adaptive Management Added – Artificial Reefs**

Coral/ Hardbottom mitigation	Construction Cost of Mitigation	Monitoring Costs	Total Costs
Artificial Reef/transplanted corals Alternative	\$13,066,911	\$508,000	\$13,574,911

### 6.7.2 Outplanted Nursery Corals

Outplanted nursery corals shall be monitored for survival and Adaptive Measurement Measures shall be taken to ensure survival remains above 80% based on the Monitoring and Adaptive Management plan found in Appendix E-5 of this plan. Survival shall be compared to control sites with similar species composition as the outplant sites to detect any region-wide changes or stochastic events like disease or a hurricane. The project shall reflect similar coral survival as the control sites for the outplanted species. Control sites shall be selected by the contractor, reviewed by the Corps and the Adaptive Management Committee and approved by the Contracting Officer.

#### Adaptive Management Committee

A committee consisting of USACE, NMFS, the implementing partner and other applicable resource agencies and will meet on a regular schedule, unless the committee determines only an as needed basis is warranted. The implementing partner will have the authority to make minor corrective actions under the contract. However, corrective actions that require major adaptive management action (e.g., site abandonment) will be reviewed by the committee and the committee will make a recommendation to USACE. USACE has the sole authority to require the implementing partner to undertake changes under the contract.

#### Minor and Major Adaptive Management Actions

The committee will define what constitutes a minor versus a major corrective action and determine if the monitoring duration should be extended. Standard coral nursery and outplant adaptive management guidelines were provided by NMFS under their cooperating agency agreement under NEPA and are included as Attachment #1 to this document. These guidelines will be incorporated into the contracting plans and specifications package for the coral propagation contract and may be modified in coordination with NMFS as new information from coral nurseries regarding nursery methods, outplant survival and other factors become available between now and plans and specifications preparation.

**Table 16 - Mitigation Costs with Adaptive Management Added – Coral Propagation**

Coral/ Hardbottom mitigation	Construction Cost of Mitigation	Monitoring and Adaptive Management Costs	Total Costs
Coral Propagation and outplanting	\$10,680,290	\$2,242,861 <sup>^</sup> (\$640,817 – monitoring & \$1,602,043 – AM)	\$12,923,151

<sup>^</sup> 6% monitoring and 15% adaptive management

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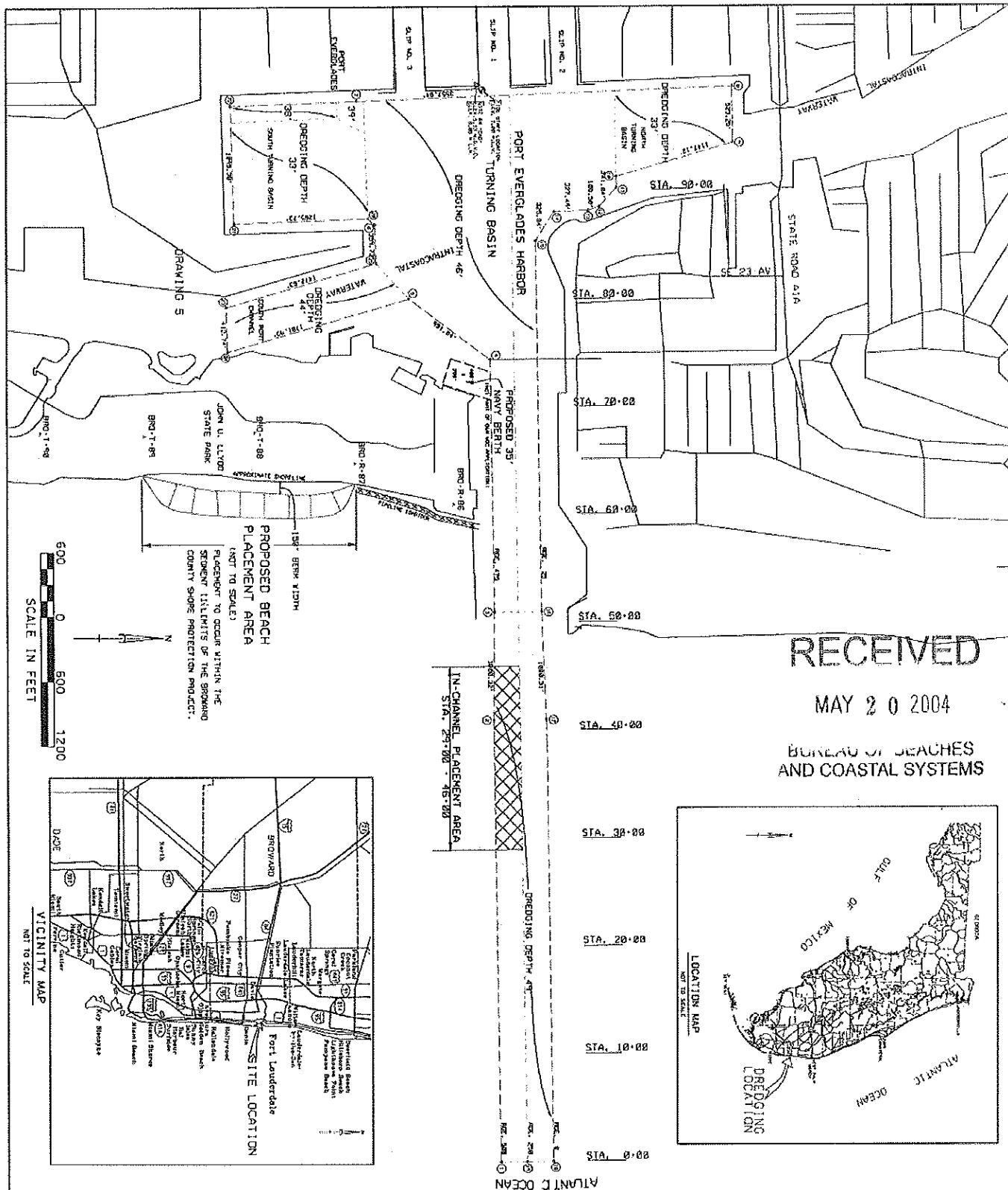
## **APPENDIX E-2**

Draft Compensatory Mitigation Recommendations of the Port Everglades Reef Group for Navigation Improvements at Port Everglades Harbor (2004)

## **APPENDIX E-4**

NMFS-Developed Mitigation Plan for Impacts to Reefs and Hardbottom Habitats

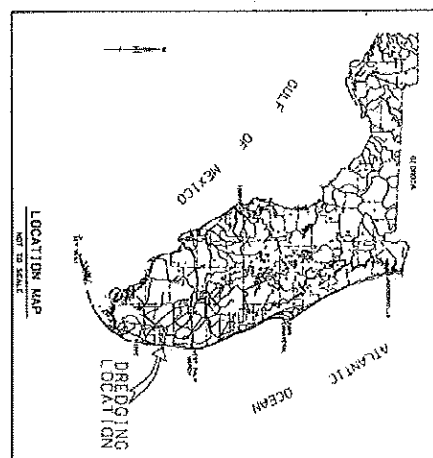
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MAY 20 2004

BUREAU OF BEACHES  
AND COASTAL SYSTEMS



DRAWINGS TO ACCOMPANY THE  
APPLICATION FOR WATER QUALITY  
CERTIFICATE SUBMITTED TO THE  
FLORIDA DEPARTMENT OF  
ENVIRONMENTAL PROTECTION

APPLICANT: U.S. ARMY CORPS OF ENGINEERS

PROJECT: MAINTENANCE DREDGING,

PORT EVERGLADES HARBOR, FLORIDA

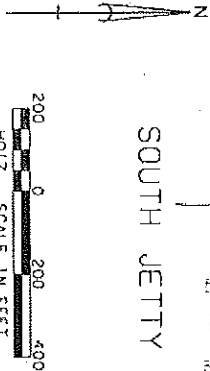
DATE: APRIL 2004

SHEET 1 OF 7

Permit No. 0220509-001-JC



NOTE: DREDGING SHOWN ARE DREDGING DEPTHS, NOT AUTHORIZED PROJECT DEPTHS



SOUTH JETTY

IN-CHANNEL PLACEMENT AREA  
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MATCH LINE DRAWING NO. 2 STA. 34+50 E.C.

STA. 57+00

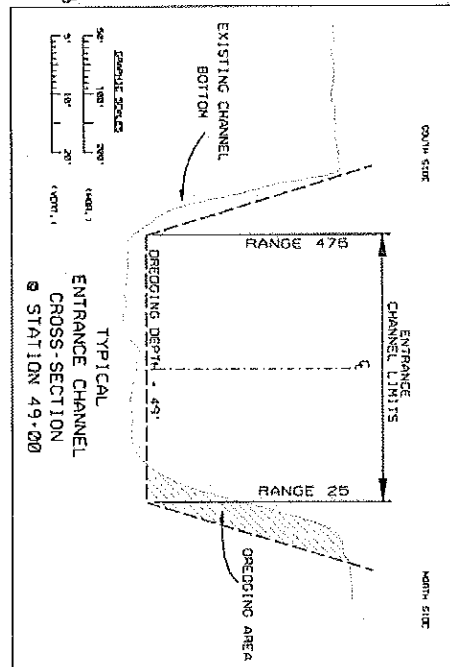
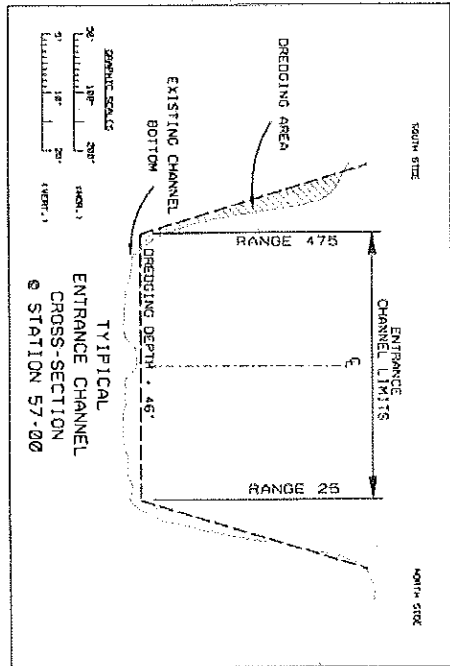
STA. 49+00

NORTH JETTY

STA. 46+00

46'

49'



DRAWINGS TO ACCOMPANY THE  
APPLICATION FOR WATER QUALITY  
CERTIFICATE SUBMITTED TO THE  
FLORIDA DEPARTMENT OF  
ENVIRONMENTAL PROTECTION

APPLICANT: U.S. ARMY CORPS OF ENGINEERS

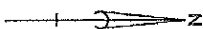
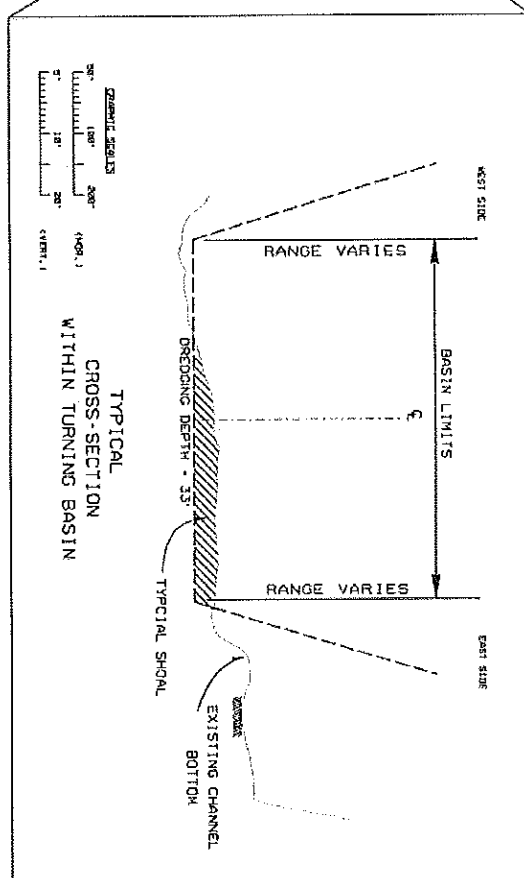
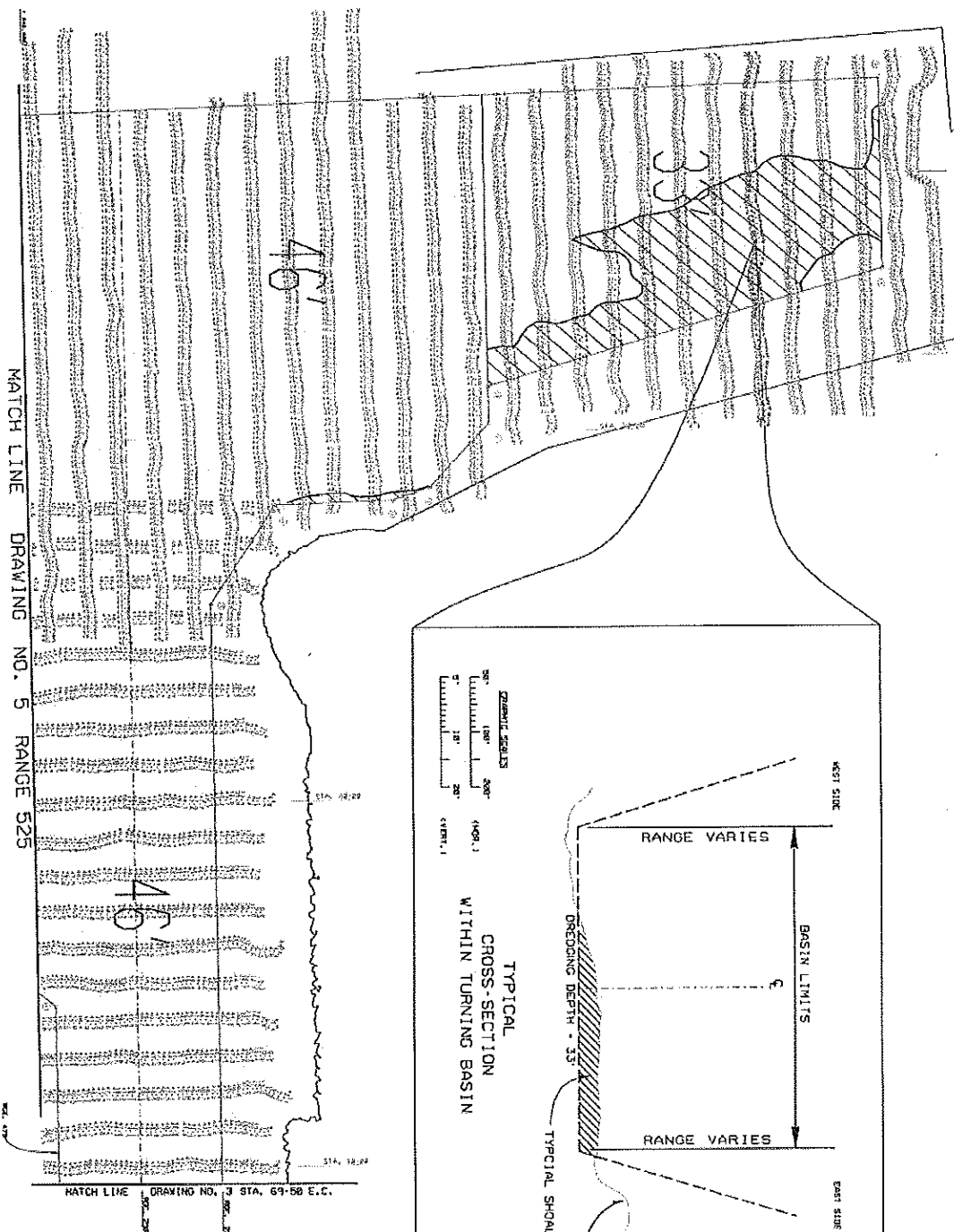
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PORT EVERGLADES HARBOR, FLORIDA

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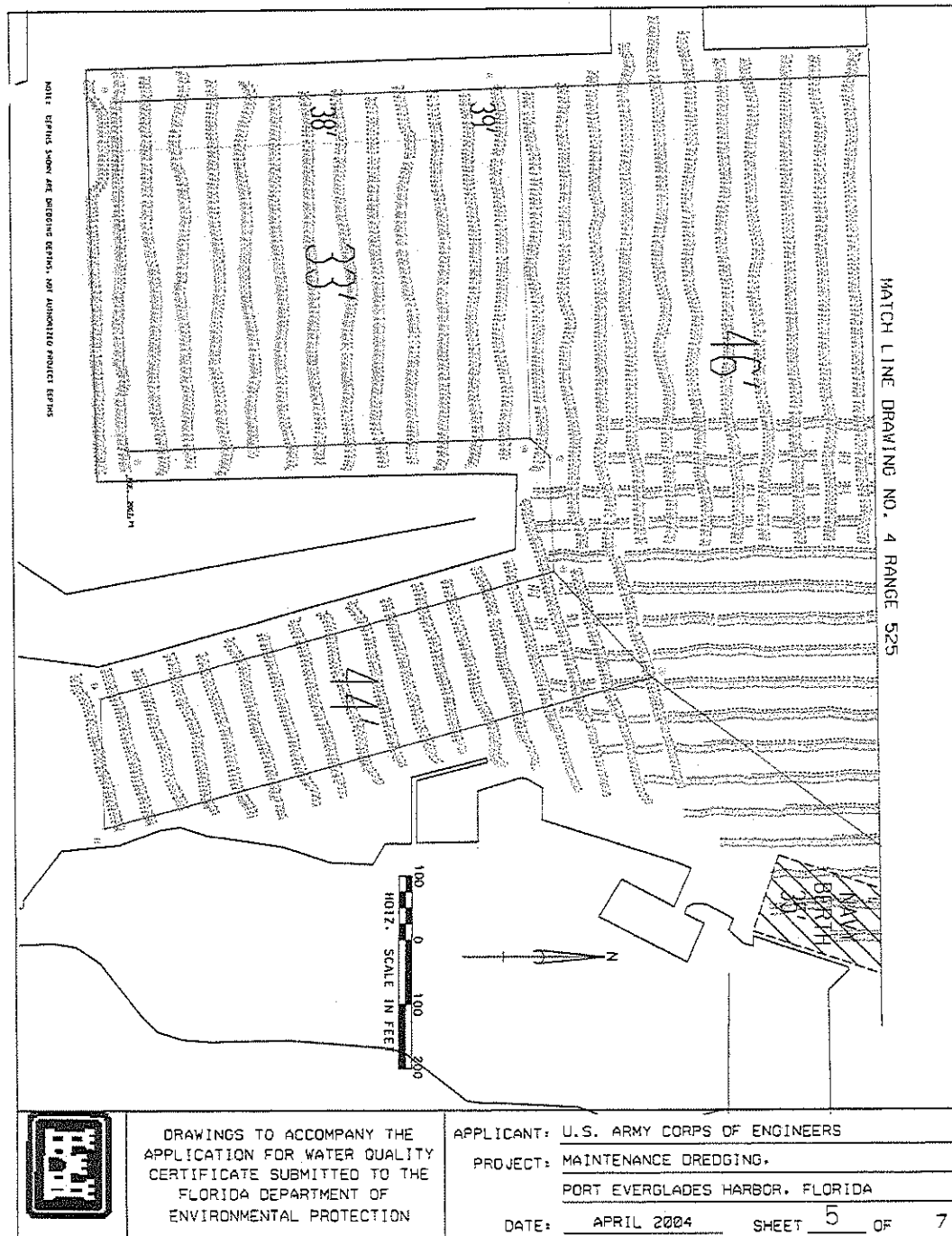


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ENVIRONMENTAL PROTECTION

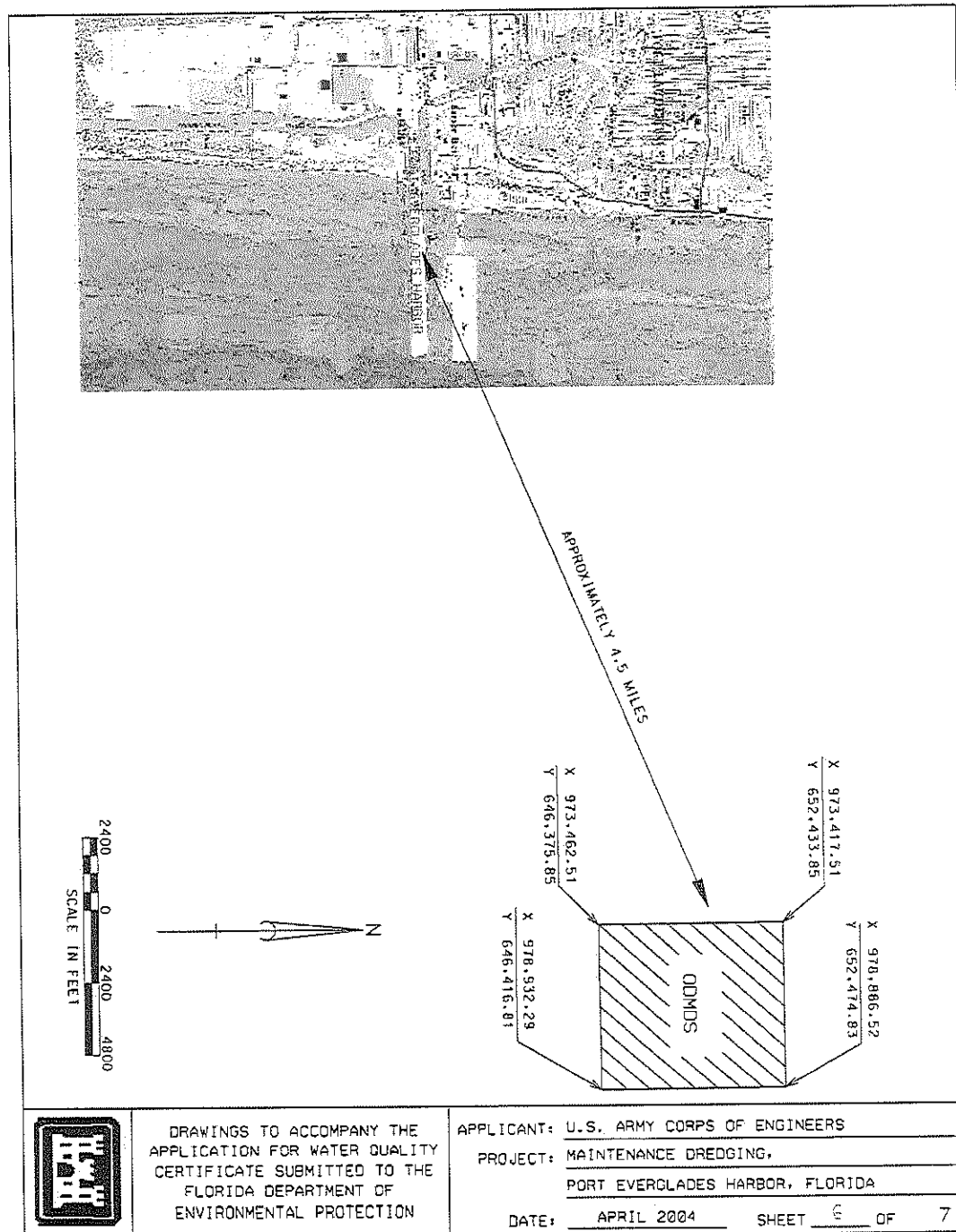
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PORT EVERGLADES HARBOR, FLORIDA

DATE: APRIL 2004 SHEET 4 OF 7

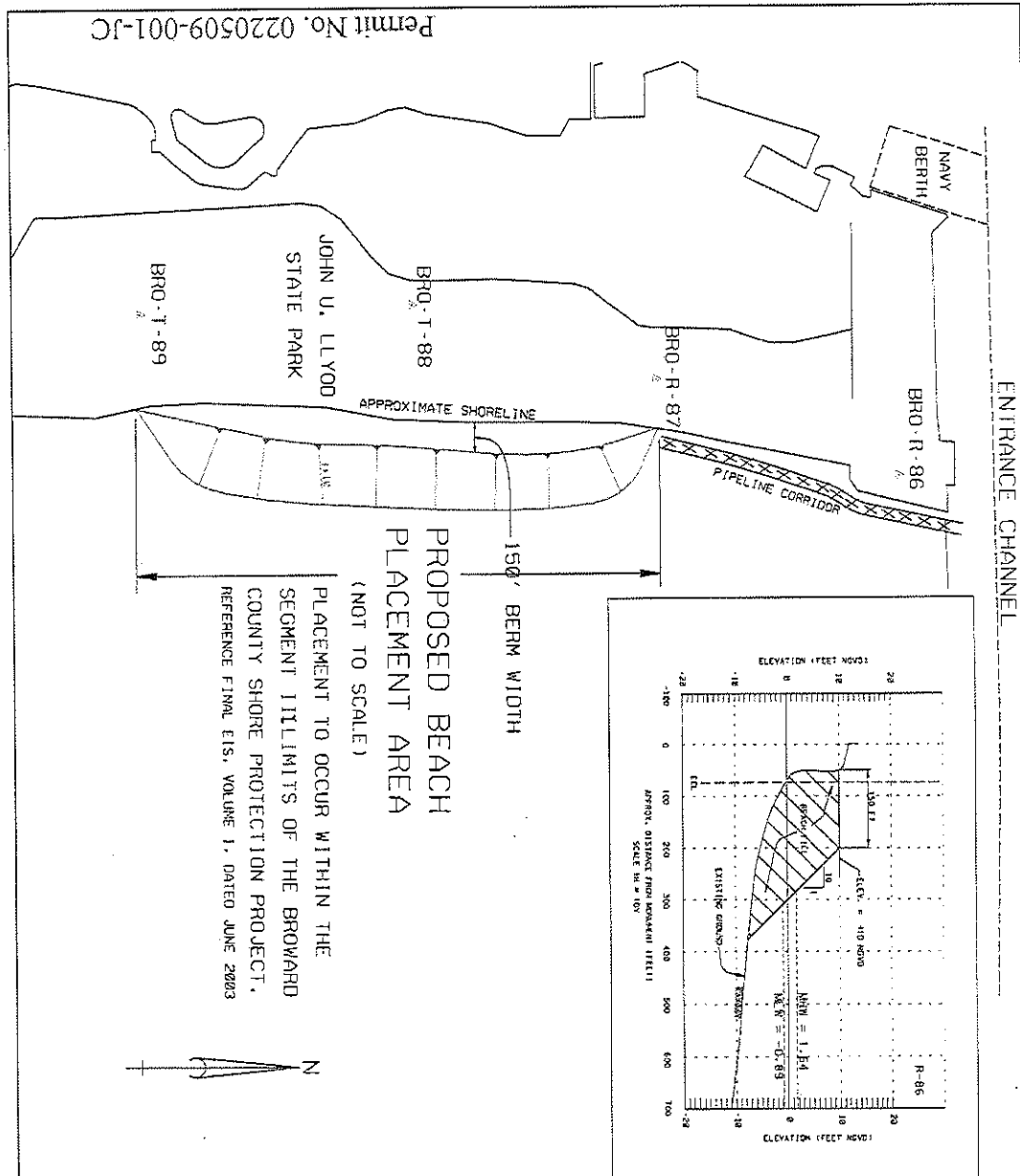
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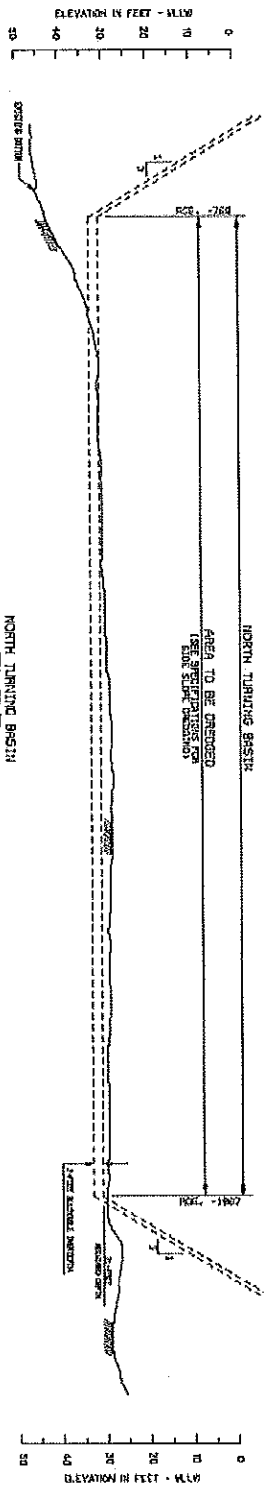
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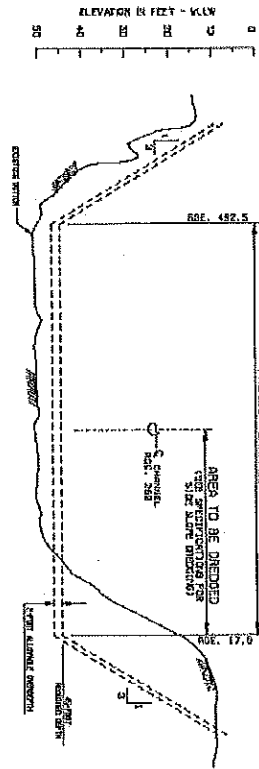
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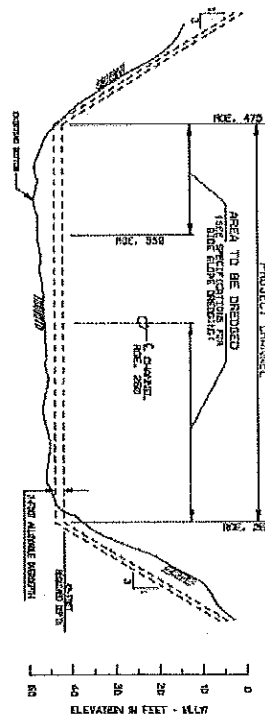
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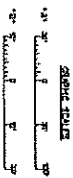
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VERT. 1" = 8'



NOTES:  
1. SEE PLAN NO. 0104 FOR  
GENERAL AND REMARKS.  
2. SEE PLAN NO. 0104 FOR  
CHANNEL, TURNING BASIN.



PORT EXTERLACHES MARINA  
MAINTENANCE DREDGING  
31-FOOT PROJECT  
ENTRANCE CHANNEL AND NORTH TURNING BASIN  
DESIGN SCOTCH

PORT EXTERLACHES MARINA  
MAINTENANCE DREDGING  
31-FOOT PROJECT  
ENTRANCE CHANNEL AND NORTH TURNING BASIN  
DESIGN SCOTCH

PORT EXTERLACHES MARINA  
MAINTENANCE DREDGING  
31-FOOT PROJECT  
ENTRANCE CHANNEL AND NORTH TURNING BASIN  
DESIGN SCOTCH

DEPARTMENT OF THE ARMY  
WATERWAYS DIVISION, CORPS OF ENGINEERS  
FORT MONROE, VIRGINIA

PORT EXTERLACHES MARINA  
MAINTENANCE DREDGING  
31-FOOT PROJECT  
ENTRANCE CHANNEL AND NORTH TURNING BASIN  
DESIGN SCOTCH

PORT EXTERLACHES MARINA  
MAINTENANCE DREDGING  
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ENTRANCE CHANNEL AND NORTH TURNING BASIN  
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PORT EXTERLACHES MARINA  
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DESIGN SCOTCH

PORT EXTERLACHES MARINA  
MAINTENANCE DREDGING  
31-FOOT PROJECT  
ENTRANCE CHANNEL AND NORTH TURNING BASIN  
DESIGN SCOTCH

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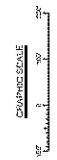
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PORT DEBARKING MOOR  
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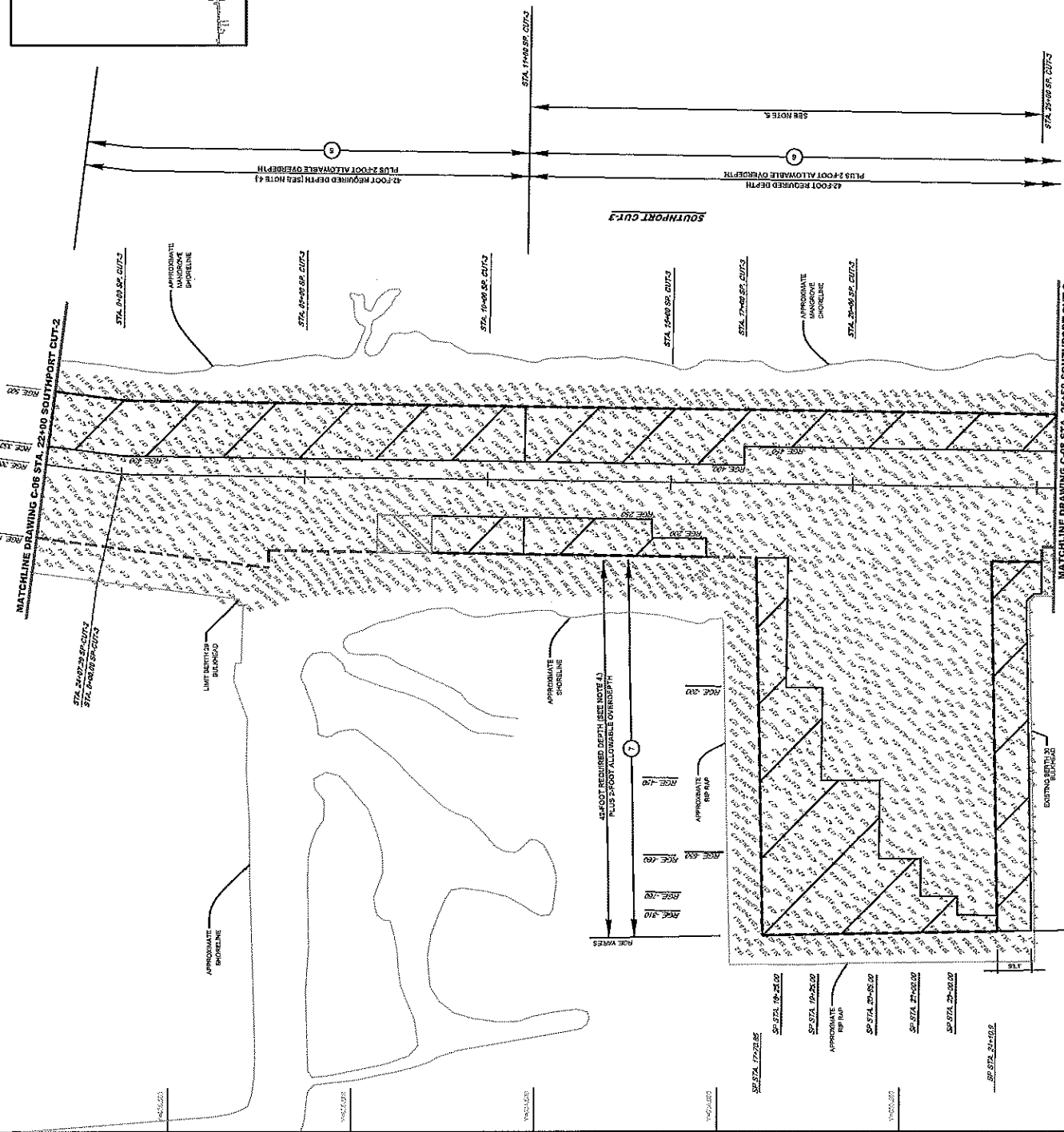
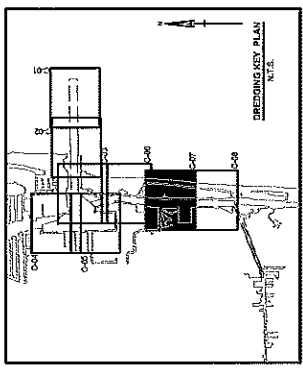
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JACKSONVILLE DISTRICT  
JACKSONVILLE, FLORIDA  
PROJECT NO. 19-00-0000  
DRAWING NO. 19-00-0000  
DATE 10/20/00

NO.	REV.	DATE	DESCRIPTION
1	1	10/20/00	ISSUED FOR CONSTRUCTION

NO.	REV.	DATE	DESCRIPTION
1	1	10/20/00	ISSUED FOR CONSTRUCTION



- NOTES:
1. REFER TO SURVEYING STATION.
  2. SEE DRAWING NO. C-06 FOR CHANNEL SURVEY NOTES.







DEPARTMENT OF THE ARMY  
JACKSONVILLE DISTRICT CORPS OF ENGINEERS  
P.O. BOX 4970  
JACKSONVILLE, FLORIDA 32232-0019

Planning and Policy Division  
Environmental Branch

Dr. Roy Crabtree, PhD.  
Regional Administrator  
National Marine Fisheries  
Service  
263 13th Avenue South  
St. Petersburg, Florida 33701-5505

OCT 11 2013

Dear Dr. Crabtree:

The U.S. Army Corps of Engineers, Jacksonville District (Corps) has received your letter dated August 13, 2013, providing Essential Fish Habitat (EFH) Conservation Recommendations for improvements to Port Everglades Harbor, Broward County, Florida. As outlined in the Draft Environmental Impact Statement (DEIS) provided to your office on June 28, 2013, the tentatively selected plan (TSP) includes deepening the Outer Entrance Channel (OEC) to an authorized depth of -48 feet MLLW (resulting in an *actual* depth of 57 feet, including overdredge and safety requirements), widen it to 800 feet on the seaward end, and extend it 2,200 feet seaward; deepen the Inner Entrance Channel (IEC) to -48 feet (50-foot actual); deepen the Main Turning Basin (MTB) to -48 feet (50-foot actual); widen the rectangular shoal region to the southeast of the MTB by about 300 feet and deepen to -48 feet (50-foot actual); widen the Southport Access Channel (SAC) in the proximity of berths 23 to 26 by about 250 feet and relocate the USCG facility to the east; shift the existing 400-foot wide SAC about 65 feet to the east from approximately berth 26 to the south end of berth 29 to provide a transition back to the existing federal channel limits; deepen the SAC from about berth 23 to the south end of berth 32 to -48 feet (50-foot actual); deepen the Turning Notch (TN) (following local-sponsor-dredging of same area to -42 feet) to -48 feet (50-foot actual) with an additional 100-foot north-south widening parallel to the SAC on the eastern edge of the SAC over a length of about 1,845 feet; widen the western edge of the SAC for access to the TN from the existing federal channel edge near the south end of berth 29 to a width of about 130 feet at the north edge of the TN; and provide compensatory mitigation for unavoidable impacts to certain resources.

During the month of September 2013, members of our respective staffs, as well as staff from Florida Department of Environmental Protection (FDEP), Florida Fish and Wildlife Conservation Commission (FWC), and US Environmental Protection Agency (EPA), participated in meetings to review impact assessments and mitigation options to determine where the Corps should review and revise as appropriate with Corps regulation and policy. Additionally, your staff, in coordination with the resource agencies prepared a revised "NMFS Combination" mitigation plan and a monitoring plan for the Feasibility Study. I want to take a moment to thank you and your staff for all of their efforts associated with these meetings. The Corps has reviewed the materials provided by NMFS and determined that some of the changes suggested in the September meetings will be adopted into our impact assessment and subsequent mitigation needs analysis. This information will also be included in the Final EIS when it is released for final public review and comment.

NMFS made the following recommendations in the meetings (some were also made as EFH Recommendations in the August 13, 2013 letter):

- a. Direct impacts associated with the channel deepening should include impacts to reef resources below dredge depth for a total direct impact of 21.66 acres.
- b. Indirect effects of sedimentation and turbidity should be for 10% functional loss and the Corps should mitigate in advance for impacts associated with turbidity and sedimentation.
- c. Direct impacts to sea grasses should be 8.45 acres of impact to habitat area able to be colonized by seagrass based on historical mapping by USACE and other agencies.
- d. Incidental Anchor/Cable impacts were calculated by NMFS of up to 19.31 acres.
- e. USACE Mitigation plan utilizing boulders is unacceptable and needs to be revised. Recommend that the NOAA propagation plan be utilized in combination with the Corps plan, i.e. some artificial reef to replace lost structural function with the remaining mitigation as *Acropora* (and other corals of opportunity) propagation over a ten-year period. NMFS recommended NMFS staff prepare a revised Habitat Equivalency Analysis (HEA) for this "Combination" plan and provide to USACE for review for policy and legal compliance.
- f. NMFS proposed to work with the resource agencies to revise the Corps' monitoring plan and provide for USACE review.

Following review of the NMFS recommendations and discussions during the September 2013 working meetings, the Jacksonville District has revised the hardbottom impact assessment, HEA, and draft mitigation plan consistent with Corps policy and guidance. The following table summarizes the NMFS recommendation and the Corps revisions.

	NMFS Recommendation	Corps Revised Plan
Direct Impact - 100% loss of function footprint	21.66 acres	16.20 acres. Remaining 5.85 acres (90% below dredge depth) will be monitored and mitigation constructed if impacts are documented.
Direct Impact initial function after construction	15% (due to removal of corals prior to construction)	0% no credit taken for coral relocation on impact avoidance
Direct Impact final function/time to recovery	15%/50 years (life of project)	15%/50 years (life of project)
Functional loss for indirect impacts	2%	2%
Time of impact for indirect impact	50 year life of project	3 year life of construction*. Actual construction of OEC is 11-14 months.
Discount Rate applied to HEA	0%	0% - per USACE policy and OMB guidance
Indirect Impact acreage	111 acres	112.59 acres
Incidental Impacts – Anchor cable	19.31 acres	17.13 acres – may be revised as more data is made available
Channel walls functional recovery level	85%, no information provided to document this level is appropriate	95%. The walls currently function at 100% with current ship traffic levels. Ship traffic will decrease with the project, but USACE is using 95% to be conservative.
Channel wall recovery time	30 years	26 years. The functional level was set at the 2007 HEA interagency meeting, which took place 26 years after last dredging. Recovery may have been earlier than 26 years, however all agencies agreed to 26 years.
Boulder reef initial function	0%	10% - as documented through the literature, placement of artificial structures in the ocean provide structure for fish, etc within days of placement.
Maximum recovery levels	50%	Reduced to 90% -

of boulder reefs		Supporting Literature - Hudson et al. 2008a, 2008b, Schittone 2010, see also Hudson et al. 2007, DERM 2004, DERM 2007, Banks (2005), Dupont (2008), Hannes and Floyd (2008), Lirman and Miller (2003). See EFH Recommendation #6 for more information.
Time to maximum function for boulder reefs	50 years	35 years. Relocation of corals from the impact area to the artificial reef will give a jump start to the boulder reef's function value. See EFH Recommendation #6 for more information.
Number of hard corals to be relocated prior to construction	18,725 corals from 21.66 acres at a cost of \$13,257,300 in addition to all other mitigation costs.	12,535 from 15.17 acres being removed for channel expansion at a cost of \$8,662,380. Although the plan provides mitigation for the impacts to 100% of 10% of the habitat below dredge depth, USACE does not plan to relocate corals from that area.

\* Because the "with project" vessel calls are less than the "without project" vessel call (USACE 2013, Economic Appendix), there are no associated increases in either turbidity or sedimentation directly associated with the deepening project beyond those for construction activities. Therefore, any turbidity or sedimentation impacts to coral or hardbottom resources adjacent to the channel associated with ship passage into or out of the harbor are not attributable to the project and will not be calculated as an impact requiring mitigation.

After completing the HEA analysis to determine the required amounts of mitigation associated with the project, the Corps revised its mitigation plan to reflect the new amounts. This mitigation plan for the Port Everglades Harbor Feasibility Study complies with Corps policy and guidance. It includes artificial reef creation of 24.04 acres for direct impacts associated with direct removal of 15.17 acres, "rubble" impacts associated with 10% of the 6.50 acres below dredge depth and indirect effects of sedimentation and turbidity during construction affecting up to 112.59 acres for up to three years of project construction. This proposed mitigation plan is the USACE-policy compliant plan. This is the Corps' final revision to the mitigation plan; however additional information including pre-construction surveys will be considered for possible incorporation. With regard to the NMFS-Combination mitigation plan presented by your staff, the Corps has determined that the proposal including propagation and transplantation has not yet been justified, particularly given the significantly greater costs to taxpayers.

The Jacksonville District requests that you begin the Endangered Species Act (ESA) consultation for this project, utilizing this new information and complete the Biological Opinion within 90-days of receipt of this letter. If a Biological Opinion cannot be completed within 90-days, please notify me as soon as possible.

A detailed response to the fourteen Essential Fish Habitat Conservation Recommendations provided by the August 13, 2013 letter is enclosed. Based on the enclosed responses, the Corps is satisfied that the consultation procedures outlined in 50 CFR Section 600.920 of the regulation to implement the EFH provisions of the Magnuson-Stevens Act have been met. This completes the Jacksonville District's requirements for EFH consultation under the Magnuson-Stevens Act. In accordance with the previously cited regulations and finding, no further action is required by the Corps unless NMFS-HCD plans to elevate to the Department of Army Headquarters in accordance with 50 CFR 600.9200(2).

The POC is Mr. Eric L Bush, 701 San Marco Blvd, Jacksonville FL 32207, telephone 904-232-1517 or Mr. Jason Spinning, telephone 904-232-1231.

Sincerely



Eric L Bush  
Chief, Planning and Policy Division

Enclosure

## Response to the Essential Fish Habitat (EFH) Conservation Recommendations

1. The USACE shall provide a mitigation plan that assumes no less than 21.66 acres of direct impacts to coral reef and hardbottom habitats.

**Response** – Concur - The Corps has revised the hardbottom impact assessment to reflect a total impact area of 21.66 acres of potential impacts in the OEC footprint, and through coordination with NMFS and other Resource Agencies, and review by higher USACE authorities, the Corps has revised the Habitat Equivalency Analysis (HEA) and Mitigation Plan/Incremental Cost Analysis to reflect this additional impact and associated mitigation required for these impacts.

Some of these areas will have 100% impact through total removal of habitat, while some will have fewer impacts due to potential incidental impacts associated with construction methodology and associated impacts from rubble moving from the construction area downslope. The mitigation plan provides mitigation for the 100% functional losses associated with habitat removal and 100% loss for 10% of the impact associated with potential rubble movement. See previous table explaining the changes to the impact assessment.

2. The USACE shall provide a mitigation plan that assumes no less than 19.31 acres of anchor impacts, in the case that the dredge equipment selected requires anchoring outside the federal channel.

**Response** – Not Concur - The Corps is unable to accept this recommendation based on available information. We request that NMFS provide the GIS shapefiles associated with NMFS' impact analysis for incidental impacts associated with anchor/cable usage during construction. The Corps has attempted to replicate NMFS analysis with both our GIS shapefiles and Dr. Brian Walker's shapefiles without success, and in an October 2, 2013 email, Dr. Walker subsequently clarified he used the 2001 LADS files, not the 2008 as stated by NMFS. When NMFS provides these shapefiles, the Corps can reanalyze the impacts and may accept NMFS' recommendations, as it did with the 21.66 acres in the OEC.

3. The USACE shall provide a monitoring plan to evaluate physical and biological impacts that may occur outside the channel. This plan shall reflect substantial input by NMFS.

**Response** – Concur - The Corps provided a monitoring plan to evaluate for physical and biological impacts that may occur outside of the channel in the Draft EIS as Appendix E-5. This monitoring plan was based on the previously permitted Key West Harbor Operations and Maintenance Dredging Monitoring and Response Plan. NMFS and NOAA-Florida Keys National Marine Sanctuary Staff were directly involved in the development of that plan as part of the project's interagency coordination team. That plan was recently taken by the Corps and submitted to the State of Florida for monitoring the potential impacts of construction activities at Miami Harbor and the State issued a permit for construction at Miami based on that plan. As stated on page 1 of the monitoring plan, any lessons learned from Miami Harbor will be incorporated into the monitoring plan prior to construction activities at Port Everglades to ensure the most recent information is utilized.

4. The USACE shall provide a mitigation plan that reflects no less than 111.87 acres of indirect impacts that would occur in the 150 meter zone surrounding the federal channel. The final EIS should clearly describe how the amounts of indirect impacts to coral reefs are determined.

**Response** - Not Concur - The Corps is unable to accept this recommendation with available information. We request that NMFS provide the GIS shapefiles associated with NMFS' impact analysis for indirect impacts associated with turbidity and sedimentation impacts associated with construction. The Corps has attempted to replicate NMFS analysis with both our GIS shapefiles and Dr. Brian Walker's shapefiles without success and in an October 2, 2013 email, Dr. Walker subsequently clarified he used the 2001 LADS files, not the 2008 as stated by NMFS. When NMFS provides these shapefiles, the Corps can reanalyze the impacts and may accept NMFS' recommendations, as it did with the 21.66 acres in the OEC.

5. In the case that blasting is required, USACE shall work with NMFS and other resource trustees to develop a monitoring program. Substantial input from NMFS shall be reflected in the final blasting monitoring plan.

**Response** – Concur - The Corps provided a monitoring plan to monitor the potential effects associated with confined underwater blasting in the Draft EIS as part of Appendix E-5, beginning on page 9. This monitoring plan was based on the previously permitted and constructed Miami Harbor Phase II project where confined underwater blasting was conducted, as well as the upcoming Miami Harbor expansion, and was coordinated with FWC, USWFS, and NMFS-PRD for their input regarding protected species that may be in the project vicinity. To date, no agency has stated that the monitoring plan for confined underwater blasting for Port Everglades is in need of additional revision. The proposed Port Everglades plan is an exact copy of the plan prepared for the Miami Harbor expansion, permitted by the state and consulted on under the Endangered Species Act by FWS and NMFS. As stated on page 1 of the monitoring plan, any lessons learned from Miami Harbor will be incorporated into the monitoring plan prior to construction activities at Port Everglades to ensure the most recent information is utilized.

6. The USACE shall update the HEA with scientifically defensible inputs on equivalency of natural coral reefs and boulder piles, recovery rates of dredged coral reef habitat, recovery rates of boulder piles, and discount rates. The final HEA shall reflect actual costs of boulder piles with substantial input from NMFS.

**Response** - Not Concur - The Corps has reviewed NMFS' recommended inputs into the mitigation plan, as provided by NMFS' HEAs during the September 2013 inter-agency working group, as well as the comments included in this August 13, 2013 letter. Many of the inputs included by NMFS are not supported by the best available scientific literature, and the Corps will not adopt them. As shown in the table previously provided in this letter, the Corps has chosen to make some changes to the input parameters of its HEA and resulting mitigation plan, however, many of our inputs remain the same and we believe them to be scientifically defensible.

*Equivalency of Natural Coral Reefs and Artificial Boulder reefs –*

The results of Miller et al. (2009) cited by NMFS are contrary to NOAA's own published studies of these same restoration sites following extensive, long-term monitoring (Hudson et al. 2008a, 2008b, Schittone 2010, see also Hudson et al. 2007). Specifically, Schittone (2010) showed that coral densities were greater in the restored area than in the reference sites and the size-class frequency distributions for the most abundant scleractinians were converging on the reference area. He also noted that the number and percentage of coral colonies by species, as well as several common biodiversity indices approximate the reference area.

The Kilfoyle et al. (2013) reference cited by NMFS evaluated mitigation sites and compared those to "nearshore" hardbottoms. These habitats are different than those of the proposed project and should be expected to be different due to water depth and substrate vertical structure and complexity. For instance, snappers and groupers spend a significant portion of their early life history on shallow, nearshore (not deeper offshore) hardbottoms so one would expect them to have higher abundances of those species in these environments.

The Gilliam (2012) reference cited by NMFS selectively cited relevant literature omitting pertinent references from previous projects. For instance, when Miami-Dade DERM (2004) conducted a review of the boulder reef constructed for the 1991-1993 dredging, two success criteria were established to evaluate the current status of the mitigation reefs:

1. Structural integrity of the individual artificial reefs has been substantially preserved, and the structures remain stable, without excessive subsidence.
2. The artificial reefs have recruited with organisms and habitat structure biologically and/or functionally similar to what was found in the impacted areas.

Their results revealed that, "Although differences between the pre-project habitat characteristics and the mitigation reef areas have been documented, the mitigation reefs have developed extensive, diverse and complex benthic and fish communities that reflect a productive and sustaining habitat. Based on the overall similarities of function provided and by these habitats and relative diversity of organisms growing on (higher species diversity for scleractinian corals on the mitigation reefs as compared to the controls), or utilizing these reef areas, it believed that these reefs are providing habitat that is minimally as productive as the reef areas impacted. Based on the foregoing, and the documented stability of the reef materials, it the determination of DERM, that the mitigation reef areas have met the Success Criterion as defined in this document."

In addition, although differences in species of fish were noted in the pre-dredging and artificial reef surveys, a review of the representation of the fish communities (i.e., at the Family level), indicate that similar functional communities exist on the combined reef materials compared to that documented during the pre-dredging surveys. Dissimilarities between the surveys are often due to representation of transient species (i.e., Jacks) or of single non-abundant species (i.e., Spade Fish, Trunk Fish). Individually, POM-B supported *a larger number of fish species*, 45 species in 17 families. POM-A modules supported 31 species in 13 families. The differences between POM A and POM-B and the natural reef hardbottom are most likely due to the larger substrate area, structure, and void space of the artificial structures. These results are identical to those of Luckhurst and Luckhurst (1978) which showed that the higher the complexity the greater the diversity and biomass of fish present. Although the POM boulder reefs are not the oldest in Miami-Dade County – they are, however, the furthest from shore, in the deepest water and show the highest density of octo- and scleractinian coral coverage of all Dade County artificial reefs. They are also the most-similar to the artificial reefs proposed at Port Everglades.

One of the most important results from the Miami-Dade (2003) Bal Harbor study was that the mitigation reefs showed very rapid colonization by a diversity of organisms including scleractinian corals. At the time of the first monitoring event in December 1999, one species of scleractinian coral had naturally recruited to the modules; by November 2001, less than two years later, some 13 species were identified (see also Jaap et al. 2006).

Banks (2005) proposed for mitigation projects in Broward County that “The topography of the limestone boulder reefs will be of greater complexity than the natural impacted hardbottom which is typically low relief limestone pavement interrupted with pockets of higher complexity. Texturally, limestone is a natural material and will provide suitable replacement for the impacted reef substrate. Thus, it is anticipated that this mitigation plan will provide perpetual reef habitat that will be colonized by organisms similar to those found on the impacted natural reef.”

Dupont (2008) evaluated limestone boulder reefs deployed off the west coast of Florida used to mitigate pipeline construction impacts on natural hardbottom ledges in the eastern Gulf of Mexico. The project's primary objective was for the mitigation reefs to mimic, not augment, natural hardbottom conditions. Species richness was similar between artificial and natural reefs, while certain commercial fish abundances were significantly higher on the artificial reefs.

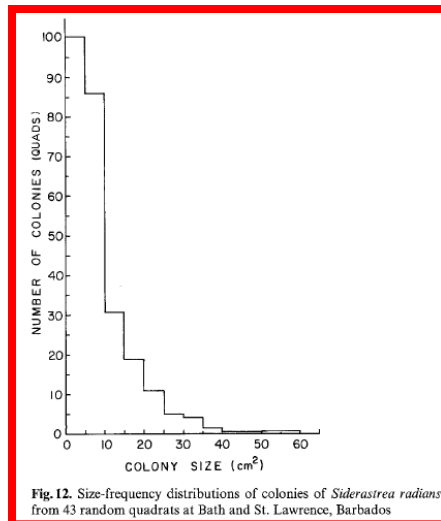
In another study in Broward County, Hannes and Floyd (2008) compared artificial to natural hardbottom coral communities by examining abundance, diversity and size class distribution over time. They found that scleractinian and octocoral abundance, diversity and average size on the artificial reef were nearly equal to those on the natural nearshore hardbottom five years post-deployment.

In studying the efficacy of boulder reefs emplaced to offset habitat impacts caused by a vessel grounding in the FKNMS, Lirman and Miller (2003) noted “Coral communities are developing rapidly on the restoration structures. Species richness and abundance of the dominant coral, *P. astreoides*, were nearly indistinguishable between the restoration structures and reference habitats after only six years.”

These numerous references all show that there is a fairly well established record of ecological success from emplaced mitigation reefs, especially the type proposed for use in the Port Everglades project. Most publications evaluating the efficacy of these projects show convergence between the control sites and mitigation reefs in much less than the 17 years stated by Gilliam (2011). While they may not exactly resemble the hardbottoms they are designed to replace, they do replace the lost ecological functions. In fact, the structural complexity created by high-relief boulder reefs often functionally outperform the reefs they are designed to replace sometimes leading to positive ecological surprises (Arena et al. 2004).

#### Recovery Rates -

Careful evaluation of the species *Siderastrea radians* from throughout the Caribbean and western Atlantic shows this species rarely grows > 10cm in its longest dimension (see figure from Lewis 1989). In the graph below the longest dimension of a *S. radians* colony with an area of 60 cm<sup>2</sup> is about 8 cm.



Moses, Swart and Dodge (2006) specifically noted "In the Caribbean, *S. radians* is generally a small, unobtrusive zooxanthellate coral species that is found predominantly in areas with higher sedimentation [Lirman et al., 2003]. Likewise, in the Cape Verde Islands, these corals are very successful in areas where they are periodically buried under 1–2 cm of shifting coarse sands. Unlike the Caribbean and western Atlantic where *S. radians* grows to a maximum size of commonly less than 10 cm in diameter [Lirman et al., 2003] and has an annual extension rate between 5–12 mm yr<sup>-1</sup> [Corte's and Risk, 1985], the same species forms broad expanses of coral pavements commonly 1–3 m in diameter and an average of 10–15 cm thick [Laborel, 1974; Moses et al., 2003]. These corals (from the Cape Verde islands) also have an unusually slow extension rate of 1.3 (±0.3) mm yr<sup>-1</sup>." These publications show that both NOAA-NMFS and Battelle (2011) used the wrong data set to calculate the growth rates of *S. radians*. While growth of *S. radians* to 25 cm is rare and exceptional, using the conservative minimum growth rate of 5mm yr<sup>-1</sup> to these largest of *S. radians* colonies in the project footprint yields an age of 50 years. Using the average growth rate of 8.5 mm yr<sup>-1</sup> yields an age of 34 years. Thus, using a recovery projection of 50 years or less is in-line with the known life history traits and growth rates of these corals and is in agreement with our earlier calculations.

*"Separately, a NMFS analysis using the very high growth rate of 5 millimeters per year for stony corals suggests that numerous coral species would have a recovery period in excess of 50 years, and likely significantly longer considering the widespread coral recruitment failure documented in the Atlantic and Caribbean (Hughes and Tanner 2000; Williams et al. 2008)."*

Based on the detailed references cited in the table below, it is clear that 5mm/yr growth rate is not "a very high growth rate" as purported by Battelle (2011) or NOAA-NMFS (2013) but actually an average growth rate for most massive (non-branching) Caribbean coral species found within the project area (the actual average is actually 5.7 mm yr<sup>-1</sup> for the 12 massive species listed in the table below).

<i>Siderastrea siderea</i>	2.2 to 7.1 mm yr <sup>-1</sup> (avg 4.65 mm yr <sup>-1</sup> )	Vaughan 1916, Landon 1975, Jaap 1984, Huston 1985, Torres and Morelock 2002, Cuevas et al. 2009, references in Dullo 2005
<i>Stephanocoenia intersepta</i>	1.8 to 8.0 mm yr <sup>-1</sup> (avg 4.90 mm yr <sup>-1</sup> )	Hubbard and Scaturro 1985, Shinn and Hudson (unpublished)
<i>Porites astreoides</i>	2.3 to 14.0 mm yr <sup>-1</sup> (avg 8.15 mm yr <sup>-1</sup> )	Vaughan 1915, Kissling 1977, Gladfelter et al. 1978, Huston 1985, Torres and Morelock 2002, Hubbard and Scaturro 1995, references in Dullo 2005
<i>Montrastraea cavernosa</i>	2.0 to 10.9 mm yr <sup>-1</sup> (avg 6.45 mm yr <sup>-1</sup> )	Baker and Weber 1975, Weber and White 1977, Ghiold and Enos 1982, Huston 1985, Hubbard and Scaturro 1985, references in Dullo 2005
<i>Siderastrea radians</i>	5.0 to 12.0 mm yr <sup>-1</sup> (avg 8.5 mm yr <sup>-1</sup> )	Vaughan 1916, Cortes and Risk 1985, Lirman et al. 2003, Moses et al. 2006
<i>Montastraea annularis</i> (species complex)	4.0 to 12.2 mm yr <sup>-1</sup> (avg 8.1 mm yr <sup>-1</sup> )	Vaughan 1915, Landon 1975, Hudson 1981, Huston 1985, Hubbard and Scaturro 1985, Bosscher and Meesters 1992, Numerous additional references in Harriott 1999, and Dullo 2005
<i>Dichocoenia stoksei</i>	2.0 to 7.0 mm yr <sup>-1</sup> (avg 4.5 mm yr <sup>-1</sup> )	Vaughan 1915
<i>Colpophyllia natans</i>	3.0 to 10.5 mm yr <sup>-1</sup> (avg 6.75 mm yr <sup>-1</sup> )	Huston 1975
<i>Solenastrea bournoni</i>	Avg 8.9 mm yr <sup>-1</sup>	Shinn et al. 1989
<i>Diploria strigosa</i>	2.5 to 10.0 mm yr <sup>-1</sup> (avg 6.25 mm yr <sup>-1</sup> )	Vaughan 1915, Hein and Risk 1975, Dodge and Vaisnys 1980, Ghiold and Enos 1982, Logan et al. 1984, Hetzinger et al. 2006
<i>Diploria labyrinthiformis</i>	3.2 to 7.5 mm yr <sup>-1</sup> (avg 5.35 mm yr <sup>-1</sup> )	Vaughan 1915, Hubbard and Scaturro 1985, Logan and Tomascik 1991

Kissling (1977) specifically showed that *Porites astreoides* colonies from the Florida Keys generally live for no more than 25 years (see figure below). Importantly, this study showed that

for corals that are mound shaped (i.e. colony diameter is longer than their measured height), that their annual linear (vertical) extension rate is lower than its lateral expansion rate. Huston (1985) found the same relationship for slow growing colonies of *Agaricia agaricites*. This growth model is referred to as radiate accretive growth (Kaandorp and Sloom 2001). Photographs in Kissling (1977), show that a *Porites astreoides* colony that is about 16 cm in its longest horizontal dimension is only about 8 cm tall (photo below). Sclerochronology of this coral yields a maximum age of approximately 15 years. Based on the above, the vertical, linear extension rate is only about 6 mm yr<sup>-1</sup> whereas its lateral expansion is more than 10 mm yr<sup>-1</sup>. Thus, for *P. astreoides* the lateral expansion rate is approximately double the vertical extension. In *Agaricia agaricites* this lateral growth can be upwards of 20-times faster than that of its linear vertical extension (Huston 1985). With the exception of some individual colonies of *Siderastrea siderea*, *Solenastrea bournoni*, *Diploria spp.* and *Dichocoenia stoksi* (which were head shaped), the preponderance of corals within the project footprint were compact and mound or inverted saucer shaped. Thus, the actual growth rates were equal to or greater than (faster not slower) than those posted in the table above which was used to calculate recovery horizons in the HEA. At the proposed Port Everglades project site the 2<sup>nd</sup> and 3<sup>rd</sup> reef terraces had ~1% coral cover. Of these, > 80% of colonies are smaller than 10 cm in diameter, >95% are smaller than 25 cm, and none are larger than 40 cm. Large, old, individual colonies while present in Broward County are quite rare and they are absent from the project area (DCA 2009).

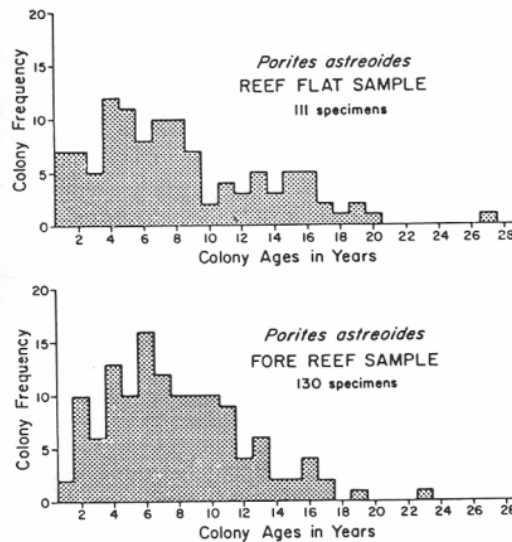
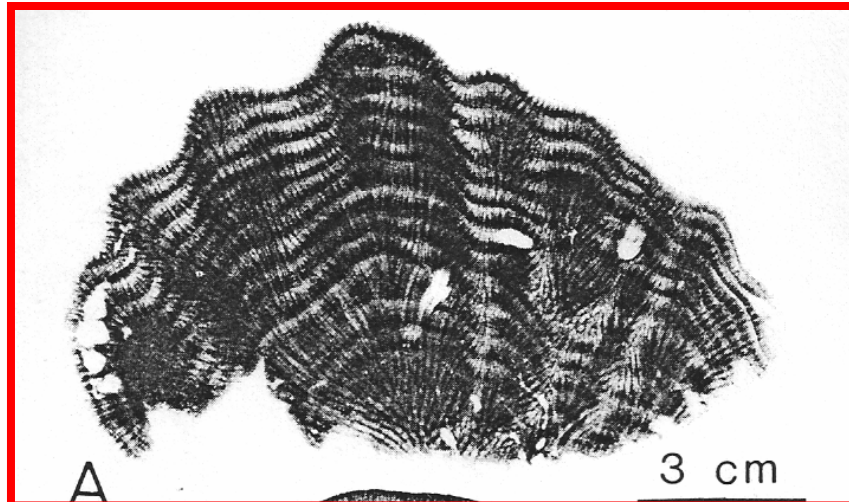


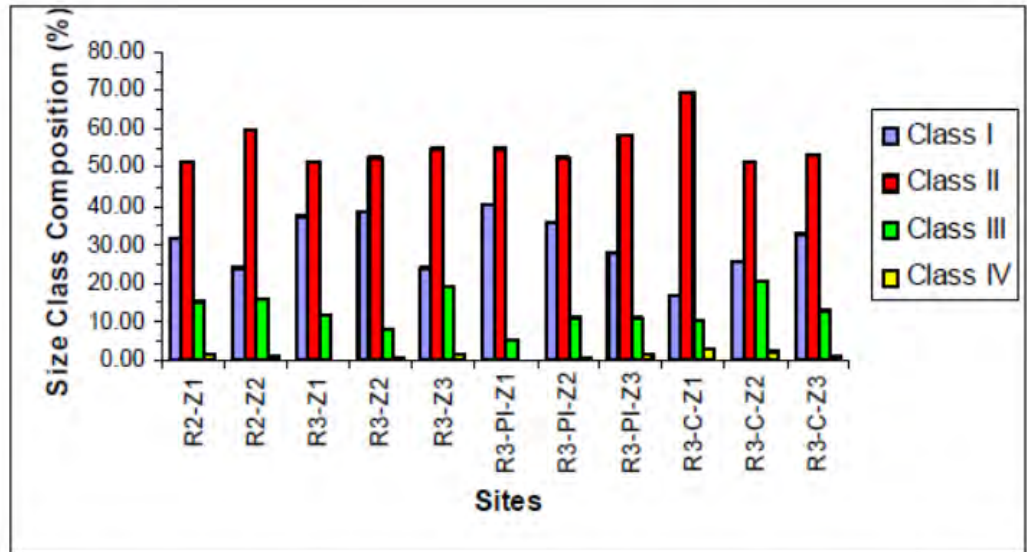
FIG. 2. — Age-frequency population structures for sample populations of *Porites astreoides* from the reef flat(above) and fore reef (below) habitats of Middle Sambo Reef.



The citation of Hughes and Tanner (2000) and Williams et al. (2008) in the NMFS-DEIS review are peculiar references to cite in this regard as both do not discuss widespread, Caribbean-wide issues of recruitment failure as purported, nor do they discuss any of the species common in the Port Everglades project area. The Hughes and Tanner (2000) manuscript describes recruitment failure in Jamaica following three successive major disturbances to the reefs there in the 1980's. These Jamaican reefs had macroalgal cover in excess of 90%, whereas the macroalgal cover on the reef terraces of Port Everglades is generally <15%. Thus, the use of Jamaica as a model to describe all reefs in the Caribbean and western Atlantic, especially those in Florida has proven to be problematic (Cote et al. 2013). The Williams et al. (2008) reference specifically discusses the recruitment failure (both sexual and asexual) of *A. palmata* to reefs in the FKNMS following the passage of four successive hurricanes from 2004-2007. Since there are no colonies of *A. palmata* in the project area (and haven't been for thousands of years) this reference has no bearing on issues affecting the reefs of Broward County in general or the Port Everglades project area in particular.

Moulding et al. (2012) observed limited levels of coral recruitment at vessel grounding sites off Fort Lauderdale. However, the most abundant recruits found at all their sites include four of five of the most common species (*Siderastrea siderea*, *Siderastrea radians*, *Porites astreoides*, and *Montastraea cavernosa*) found in the Port Everglades project area.

It should also be noted that the measured size-class data for corals within the project footprint are all strongly skewed to the right (see Figure 10 from DCA 2009 below).



**Figure 10. Distribution of scleractinian colony sizes (diameter) within reef site and zone as encountered in visual belt transects off Port Everglades in March 2006. Class 1 = 0-3 cm; Class 2 = 4-10 cm; Class 3 = 11-25 cm; Class 4 = 26-50 cm; and Class 5 = > 50 cm. [R = Reef; Z = Zone; PI = Previously Impacted; C = Control]**

Species that attain large sizes live longer and are less dependent on frequent recruitment, and consequently populations tend to become 'impoverished' in small colonies, resulting in size-frequency distributions that are skewed to the left, while small species are more skewed to the right. These data indicate a general dichotomy in coral life-history strategies with respect to colony size, with small species generally having a shorter lifespan and reproduction being relatively frequent and successful. Thus, new input into smaller size classes occurs continuously. This size-class structure is similar to that found in Broward County.

In their simulation model, Lirman and Miller (2003) noted the importance of recruitment on the recovery rate for coral reef restoration. This modeling involved opportunistic species with relatively high recruitment rates such as those that predominate in the Port Everglades project area. Thus, for a coral reef initially dominated by more opportunistic corals, English et al. (2009) noted that the assumption of a 50-year period to reach maximum coral reef services may be excessive as judged by the metric of population recovery of the dominant corals (size x annual growth rate).

<b>Project</b>	<b>Reef Habitat Affected</b>	<b>Recovery Horizon used in HEA</b>	<b>Type of Compensatory Mitigation</b>
Broward County Beach Nourishment	Nearshore Hardbottoms	In perpetuity (buried)	LS Boulder Reef
Hillsboro Inlet	2 <sup>nd</sup> and 3 <sup>rd</sup> Reefs	35 years	LS Boulder Reef
Americas II Cable	2 <sup>nd</sup> and 3 <sup>rd</sup> Reefs	35 years	Artificial Reefs (DERM Modules)
Arcos Cable	2 <sup>nd</sup> and 3 <sup>rd</sup> Reefs	35 years	LS Boulder Reef
Columbus Cable	2 <sup>nd</sup> and 3 <sup>rd</sup> Reefs	35 years	Artificial Reefs (DERM Modules)
Igloo Moon Grounding Biscayne National Park	High-Structured Reef Spurs	43 years	Emplacement of Quarried LS Boulders
Allie B Grounding Biscayne National Park	High-Structured Reef Spurs	43 years	Emplacement of Quarried LS Boulders
Bal Harbor Dredge – Borrow Area Miami-Dade County	3 <sup>rd</sup> Reef	35 years	176 Artificial Reef Modules 8,000 tons of LS Boulders (3-6 ft. diameter)

The preponderance of HEA's performed throughout the region have historically used recovery horizons <50 years based on the known coral populations at the project sites (see table above).

Thus, based on all the above, the recovery rates used in the USACE HEA are conservative estimates based on the protocols established in Zengel and Hinkeldey (2001) NOAA guidance document and were calculated using the best available peer-reviewed science coupled with in situ field measurements.

*Boulder Reef Recovery Timeframes -*

The Port Everglades Agency "Core" Group (meetings in 2007) agreed to a 10-year discount for relocated corals (HEA Appendix B, meeting notes). This allowance was based on previous projects and HEA's performed in Broward County. Recovery rates were estimated for both components using a similar boulder mitigation project established for a representative beach

nourishment project (Kohler and Dodge 2006). In the Kohler and Dodge (2006) analysis it was assumed that the mitigation boulders will recover to 100% full services in 50 years naturally. However, they would recover to 100% full services in less time (15 years in their example) by transplanting corals onto them. The rationale for 15 years was chosen because all corals greater than 15 years old “*were to be removed from the area slated for injury and these would be used for transplantation.*” By transplanting corals, the mitigation boulders **will begin recovery not at 0% of full services, but at some higher value. A level of 10% immediate gain of services was assigned** (Kohler and Dodge 2006). This immediate gain, no matter what the origin of the donor corals, is real and must be accounted for in the services provided by the mitigation reefs. Besides the immediate service gain as a result of the transplantation, it is anticipated that localized coral recruitment to the mitigation boulders will be enhanced (facilitated) by the transplants. As FDEP recently summarized in their Up-Town Palm Beach County UMAM:

*“[I]mprovements in benthic community support functions include immediate increases in coral and diversity at the transplantation receiver sites. The 1-acre area around each receiver site would be positively affected by higher recruitment and settlement rates, higher coral and octocoral and benthic invertebrate diversities, and increased diversity of fishes.”*

Thus, with time, it should be difficult to distinguish between transplanted corals and those that recruited naturally to the mitigation boulders. No additional credit was allotted in the HEA due to this anticipated gain in services which could be highly significant over the life of the project. As noted above, past mitigation projects have shown that the convergence of coral species between mitigation reefs and natural hardbottoms could be rapid resulting in coral service gains exceeding 100% (as measured in percent cover and number of colonies per unit area).

FLDEP also noted in their Mid-Town Palm Beach County UMAM that “The goal of the artificial reefs is to create high complexity/high relief reef to increase available surface area for ‘corals of opportunity’ and optimal substrate for coral recruitment/survivorship.” The Port Everglades mitigation project provides all the above mentioned services.

#### Discount Rates -

The use of a 0% discount rate on this and other water resource development and improvement projects is an USACE HQ policy decision. Thus, the input of 0% into the HEA follows Corps policy. Although the Corps originally submitted the HEA with a 3%, during model review and HQ policy review, it was determined that the use of a 3% discount rate was not compliant with USACE and the Office of Management and Budget (OMB) policy as the HEA was deemed to be an ecosystem model because the outputs from the model were not monetary, a 0% discount rate must be used. Federal water resource development projects covered under the “Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies” (P&G), are limited by the statement “monetary or NED outputs are discounted”. This means environmental outputs from HEA are not authorized to be discounted for any project covered by the P&G (published through the Council on Environmental Quality/Office of the White House). pg E-154 c(1) [CE/ICA procedures] of the Engineering Regulations 1105-2-100:

"Ecosystem restoration outputs are not discounted, but should be computed on an average annual basis, taking into consideration that the outputs achieved are likely to vary over time."

OMB Circular A-94 states “Specifically exempted from the scope of this Circular are decisions concerning water resource projects (guidance for which is the approved Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies).” These requirements prevent USACE from discounting the HEA. In the August 13, 2013 letter, NMFS states “*USACE Guidance documents available for FY12 appear to indicate the USACE should use a discount rate of 4 percent for planning projects*”. This comment refers to the annual HQUSACE publication of guidance on discounting to the Districts each fiscal year. The cover page of this document states: "The P&G states discounting is to be used to convert future monetary values to present values." HEA outputs do not result in monetary values and are not covered by this annual guidance.

7. The USACE shall adopt a compensatory mitigation plan that is the most technically sound approach to offsetting the loss of coral, coral reef, and hardbottom habitat. The final coral reef mitigation plan shall not take credit twice for coral relocation. The final coral reef mitigation plan shall reflect input from NMFS.

**Response** – Partially Concur - The Corps has revised its mitigation plan based on the revised impact analysis and HEA results. This plan is the Corps policy-compliant plan. However, the Corps is unable to accept many of NMFS inputs as they do not appear to be supported by the greatest volume of peer reviewed literature specific to southeast Florida. Many of the citations utilized by the Corps in preparation of our HEA and mitigation plan were discussed above in Response #6, and by utilizing the information included in Response #6, the Corps believes that it has prepared the most technically sound approach to offsetting the loss of coral, reef and hardbottom habitat associated with the project. The Corps’ mitigation plan did not take double credit for coral relocation. The Corps took the benefit of coral relocation as a benefit to the artificial reef and did not claim any credit for that relocation in the upfront functional loss associated with construction of the project. A review of the benthic baseline analysis conducted for the impact areas of Port Everglades did not find any corals greater than 50cm in size. Based on this, the Corps disagrees with NMFS’ characterization that the Corps’ mitigation plan took “double credit” for relocation of corals from the impact area.

8. As a project minimization measure, the USACE shall relocate all corals in accordance to Table 2 in the draft EIS Appendix E-4. Coral relocation shall occur in expansion areas and previously dredged areas. The coral relocation plan should include clearly defined performance standards, monitoring protocols, and schedule.

**Response** – Not Concur - At this time, the Corps mitigation plan is that ALL corals  $\geq 10$  cm, and that are within the area of direct impacts, will be relocated to both constructed boulder reefs and/or adjacent natural hardbottoms prior to dredging. There are no plans to relocate corals in the “below dredge depth” impact area because the Corps does not agree with NMFS’ assessment that there will be a 100% loss of coral function downslope from the construction area due to “rubblization”. Instead, the Corps will mitigate upfront for a 100% loss in 10% of the area and will monitor for effects to coral habitats downslope, should monitoring show a  $>10\%$  impact to downslope habitats, the Corps will develop additional mitigation for the loss of those resources. The Corps believes that leaving these corals in place during construction will have less of an impact than relocating them and having many of them die after relocation to the artificial reefs or adjacent natural reefs (see transplant survival discussion below).

This is essentially the same as the present permit requirement for corals to be moved within the Port Miami project footprint, except that the Corps is currently proposing to relocate 32% more corals than required to be relocated for the Port of Miami project. At the Port of Miami, the Corps was required to relocate up to 68% of all corals in the direct impact footprint  $\geq 10$  cm in size and all corals  $\geq 25$  cm with all transplanted corals having an  $\geq 80\%$  survival rate for five years. However, the NMFS comments state to increase this target to 90%. Prior transplantation efforts performed on restoration projects in Broward County shows highly variable, species specific results (CSA 2004). This included a post-transplant survivorship of only 76.5% for *Montastraea cavernosa*; one of the most common species found in the Port Everglades project footprint. Moreover, a 90% success criterion is untenable based on the natural survival of coral species in the wild. For instance, Thornton et al. (2000) noted a fairly high overall success rate (87%) for relocating and transplanting corals of essentially the same suite of species as those found in the Port Everglades project footprint. However, Thornton et al. (2000) noted that at their control sites in Broward County corals had an 83% survival rate (17% mortality) over only a two-year period. To track the fate of individual corals, Gilliam (2011) tagged and monitored a number of species within the SFCREMP sites. Of the original 49 colonies he tagged in 2006, only 23 were found alive in 2011, only a 46% survival rate. Much of these losses were attributed to corals becoming dislodged and lost. This high-turnover of corals helps to explain why the coral community in Broward County is dominated by small corals. The Corps cannot determine how the Corps' relocation project can be expected to have a greater success criterion than that of the natural reef community if turnover in this environment is so high.

Further, NOAA-NMFS requests to move many corals  $< 10$  cm. It has long been known that within species of scleractinian reef corals, rates of total colony mortality are inversely related to colony size (Soong 1993). Thornhill et al. (2011) showed that corals with low biomass are more susceptible to death following stress. Harriott and Fisk (1998) commented that the feasibility of transplanting small colonies was likely to fail due to the extremely high mortality rates of small fragments, even for taxa that reportedly fragment naturally. Thornton et al. (2000) specifically noted that smaller corals have a greater mortality rate than larger colonies. Unfortunately, Thornton et al. (2000) did not provide a breakdown of size-class data making it difficult to determine which species in which size classes responded best (or worst) to transplantation. If smaller corals are required to be moved, a drastic reduction of the transplantation success criteria should also be required. Finally, NOAA-NMFS (2013) listed a number of additional references (Stephens 2007; Brownlee 2010) as evidence for the success of transplanting smaller corals. Unfortunately, neither of these references are peer-reviewed – they are both unpublished MS theses from Nova Southeastern University and cannot be found or accessed electronically through any commonly used scientific database queries (e.g. Google, Google Scholar, Science Citation Index [SCI], and Aquatic Sciences and Fisheries Abstracts [ASFA]). In addition, neither of these authors could be found as having published or presented their data, results, or interpretations at any scientific meetings or workshops.

9. The USACE shall update the EIS to evaluate the potential for the deepening and widening of the OEC to create a “sink” or trench whereby coral fragments and larvae moving northward or southward along the reef line fall into the channel and become no longer viable. This update to the EIS shall reflect significant input from NMFS.

**Response** – Concur - The Corps included a detailed assessment of this comment originally provided by NMFS in 2011 in Section 4.5.10.2.2 of the EIS as well as in the September 2012 Biological Assessment provided to NMFS as part of the ESA consultation materials. We believe this recommendation has already been met.

“Deepening of the entrance channel and dredging the flare is not expected to impact any biological functions of acroporid corals (feeding, breeding, settling, etc). Concern has been expressed that deepening the existing channel and dredging the flare in the outer reef may create a “sink” that fragments of acroporid corals could fall into and not escape, thus creating a physical blockage to fragments of acroporid corals moving north with the currents, thus hindering reproduction. USACE has reviewed the available information regarding acroporid life history strategies and the known locations of *Acropora spp.* throughout south Florida, specifically focusing on colonies in the vicinity of the entrance channels, and find this concern to be unwarranted. USACE has been unable to locate any research studies, monitoring reports or other publications that discuss this issue in any detail specific to *Acropora* species. There are 14 deepwater navigation channels; three of which are currently slated to be deepened in the next 2-10 years located within Designated Critical Habitat (DCH). This issue was not identified in the pending draft Recovery Plan for *Acropora spp.* (in press) (that USACE reviewed as part of the recovery plan development team) as a potential hindrance to species recovery. USACE was able to determine that there are two deepwater entrance channels within 25 miles of each other within DCH for acroporid corals: Miami Harbor and Port Everglades, both of which have been dredged to 45 feet. Miami was initially constructed late in 1905, and Port Everglades was originally constructed in 1927. Miami was deepened to its current depth with deepening resulting in all three offshore reefs being cut, in 1991 and Port Everglades was deepened to -45 feet and widened from 300 feet to 500 feet in 1981. *A. cervicornis* has been documented at Miami Harbor on the southern edge of the entrance channel and additional colonies have been documented on the northern side of the channel, within 200-feet of the channel edge (DC&A 2010a; DERM 2008), unlike Port Everglades where the closest documented colonies of *A. cervicornis* are 2,780 feet to the south of the channel and 1,400 feet north of the channel by USACE surveys, a survey conducted by the Navy in 2011 documented *Acroporacervicornis* on the first reef, south of the channel approximately 450 feet from the channel. Neither channel has *A. palmata* documented as being in close proximity. Since the early 1980s, *A. cervicornis* has been documented as expanding its range northward through Broward County and into Palm Beach County (Vargas-Angel *et al.* 2003, Precht and Aronson 2004), into areas previously documented as being devoid of acroporid corals in the 1970s 1980s and even the 1990s and early 2000s, or where acroporid corals were documented as being rare (*A. cervicornis*) or absent (*A. palmata*) (Goldberg 1973).

As is similar to the case above, the first observations of living *A. palmata* were made on the reefs of the Flower Gardens Banks (FGB) in 2003 and 2005 (Zimmer *et al.* 2006). These discoveries were also the deepest records of extant *A. palmata*, at water depths down to 23 m. The FGB are located more than 690 km from the nearest emergent reefs

dominated by *Acropora* (Jordan-Dahlgren and Rodriguez-Martinez 2003; Schmahl *et al.* 2008). Ocean current models indicate that the reefs in the southern GOM are the most likely sources of larval immigration to the FGB (Bright *et al.* 1984; Lugo-Fernández, 2006); however, larval supply from the Meso-American reef tract, Cuban reefs, and the Florida reef tract are also possible (Rezak *et al.* 1990; Biggs, 1992; Lugo-Fernández *et al.* 2001; Lugo-Fernández 2006; Johns and Lamkin 2008). Initial results of genetic analysis reveal that the source of the recent *A. palmata* colonies is the western Caribbean (Iliana Baums, unpublished data 2012). No further subdivision of the western Caribbean population is apparent and thus more precise assignment to potential source locations is presently not possible (Baums *et al.* 2005, 2006). One of the most important aspects of the discovery of living acropoid corals at the FGB is the implication that viable *A. palmata* larvae had to be competent for sufficiently long durations allowing them to recruit to the surfaces of the reef caps, wherever their source locations were. The same can be said for the *Montastraea annularis* species complex, which also broadcasts its gametes into the water column and is presently the dominant species at the FGB (Szmant and Meadows 2006). Hence, in addition to temperature, dispersal and larval duration may help explain the ranges of these corals in time and space (Davis *et al.* 1998; Mora *et al.* 2003).

There are several natural breaks in the 2<sup>nd</sup> and 3<sup>rd</sup> reefs located between the Miami and Port Everglades channels, including one in the third reef that is more than 1,000 meters wide located more than eight km south of Port Everglades and *Acropora cervicornis* has been located north of this natural break on the third reef. Since acroporid species reproduce predominately through fragmentation (NMFS 2005a) and there are natural breaks in the 2<sup>nd</sup> and 3<sup>rd</sup> reefs located between the Miami and Port Everglades entrance channel more than seven times wider than the cut proposed for the channel extension (500 feet/ 0.15 km), USACE concludes that *Acropora sp.* corals are capable of reproducing over large geographic area as demonstrated by the FGB *Acropora*, and that these dredged channels that are narrower in width than natural breaks in the reefs have not previously hindered, nor will they hinder in the future after deepening, the continued ability of fragments of acroporid coral species to migrate northward and continue to expand the species range in southeast Florida, as habitat conditions warrant.”

10. The USACE shall update the EIS to describe no less than 8.45 acres of seagrass habitat impacts. The EIS shall be updated to include historically mapped and ground-truthed seagrass habitat areas that would be eliminated by dredging and no longer available as contraction and expansion habitat.

**Response** – Concur - The Corps has agreed to modify the impact analysis for seagrasses to include seagrass habitats that have previously supported habitat, yet may not be occupied by sea grasses at the time of construction and determine appropriate mitigation associated with those impacts. These areas were previously groundtruthed by in-situ surveys and the in-situ surveys will be updated prior to construction during the PED phase of the project.

11. The USACE shall update the EIS to describe indirect impacts to seagrass habitat. This update shall reflect input from NMFS. Specifically, NMFS requests USACE update the EIS to identify each seagrass impact polygon on a map and provide a narrative that explains how the impact area was calculated for each seagrass impact area.

**Response** – Partially concur. The Draft EIS has already discussed the potential for indirect effects to sea grasses in Sections 4.4.1.2. If NMFS disagrees with the analysis included in the EIS, NMFS may work with USACE to revise the language under their role as a cooperating agency. USACE will include electronic maps of each seagrass polygon on the CD with the final EIS as an appendix, however these will not be printed in the EIS. Each of the individual seagrass assessment reports include a description of the methodology utilized to map these habitats. All of the reports are found in Appendix D. Specifically - 2001 Baseline Report – Section 2.0, pgs 6-12; 2009 Seagrass mapping – Section 2.0, pgs 1-6; 2006 Seagrass mapping – Section 2.0, pg 1-6.

12. The USACE shall develop supplementary compensatory mitigation for seagrass impacts to account for the loss of all seagrass habitat that has been historically mapped and ground-truthed and will become unavailable as habitat after the dredging occurs. The additional mitigation shall appropriately address seagrass impacts that occur closer to or within the inlet. The plan shall address how the site selection for mitigation locations is supported by the best available literature. This plan should include clearly defined performance standards, monitoring protocols, and schedule. The mitigation amounts shall be based on a functional assessment that reflects NMFS and other resource trustee input.

**Response** – Partially Concur – The Corps will update the impact UMAM assessment for impacts to habitats which have previously supported sea grasses, but as of the last seagrass survey were unoccupied by visible seagrasses. This UMAM will be used in conjunction with the Port, Broward County parks and the on-going West Lake Park Ecosystem restoration project that is supplying the mitigation credits for sea grasses to the Port project. USACE will coordinate with the agencies, as well as our Regulatory division regarding inputs into this updated assessment.

13. The USACE shall update the cumulative impacts section and description of cumulative impacts to coral reefs and water quality. The EIS should be updated to acknowledge the findings of Walker et al. (2012) that Port Everglades has historically dredged 58.5 acres of hardbottom and buried 178 acres of Outer Reef as dredged material disposal, which resulted in the loss of over six million corals and approximately 180 acres of live coral tissue area.

**Response** – Partially Concur – the Corps will incorporate the applicable information included in Walker *et al.* (2012), however, we included an estimate of impacts in Section 4.29.6 of the EIS associated with dredging of the Port Everglades Federal Navigation Project between 1927 and 2012. Specifically, Figure 79 provided the estimated total impact of 100.13 acres associated with the historic construction dredging of the Outer Entrance Channel, with 59.4 acres being either reef or hardbottom habitats. Walker *et al.* (2012) assumes that all “burial” materials are directly linked to the historical Port dredging. The Cumulative Effects Analysis did not include burial of habitats associated with authorized disposal operations, since in some cases, the disposal location for the material was not documented (original construction and dredging up to 1960s no documentation is available to support disposal locations), and thus cannot be definitely linked to the harbor dredging. The Corps will include an estimate of impacts associated with the disposal operations for the 1965 dredging where the dredged material was sidecast north of the OEC and did result in habitat burial. After 1965, all material disposal occurred offshore in deepwater beyond the continental shelf resulting in no burial of the reefs offshore of Broward County. Additionally,

there are no available data that the Corps is aware of that documented coral cover and number of corals in the area that was dredged in 1927-1928 to create “Hollywood Harbor”, now known as Port Everglades. The current assessment of coral cover (DCA 2009) shows an average coral coverage of approximately 1.4/m<sup>2</sup>, significantly lower than the average coral cover of 2.6/m<sup>2</sup> cited by Dr. Walker, and thus Walker (2012) significantly overestimates the numbers of corals that may have been impacted. Due to the lack of this data and the application of coral cover of 2.6/m<sup>2</sup>, the Corps will not adopt this estimate in the Cumulative Effects Analysis.

14. The USACE shall require use of best management practices (BMP) to avoid and minimize the degradation of water quality and minimize impacts to hardbottoms and seagrass habitat, including the use of staked turbidity curtains around the work areas, marking of seagrass and hardbottom habitat to facilitate avoidance during construction, and prohibiting staging, anchoring, mooring, and spudding of work barges and other associated vessels over seagrass and hardbottom. These BMPs shall be coordinated with NMFS for approval prior to commencement of any work minimized project impacts.

**Response** – Partially Concur. The Corps requires contractors to utilize best management practices (BMP) in all construction projects, and the EIS specifically listed BMPs that would be employed in Section 4.4.2.2 of the EIS. By federal law, only the Contracting Officer or the Contracting Officer’s Representative may approve of contractor’s submittals and plans, and as such, NMFS will not be given approval authority over any aspect of the construction associated with Port Everglades. However, the Corps will work with NMFS to review draft plans and specifications developed for the project, just as the Corps has done with other resource agencies with specific resource concerns on projects throughout the District.



UNITED STATES DEPARTMENT OF COMMERCE  
National Oceanic and Atmospheric Administration  
PROGRAM PLANNING AND INTEGRATION  
Silver Spring, Maryland 20910

AUG 13 2013

Colonel Alan M. Dodd, Commander  
U.S. Army Corps of Engineers, Jacksonville District  
PO Box 4970  
Jacksonville, Florida 32232

Dear Colonel Dodd:

The National Oceanic and Atmospheric Administration (NOAA) has reviewed the U.S. Army Corps of Engineers (USACE) Draft Environmental Impact Statement (EIS) entitled *Navigation Improvements – Port Everglades Harbor, Broward County, Florida*. Comments are included from the National Marine Fisheries Service (NMFS), representing NOAA as a cooperating agency on the referenced EIS. NMFS was invited to cooperate on the EIS by the USACE in light of NMFS' jurisdiction over, and expertise in, essential fish habitat (as defined by the Magnuson-Stevens Fishery Conservation and Management Act) and threatened and endangered species (as defined by the Endangered Species Act).

In brief, NOAA believes that the referenced Draft EIS significantly understates the project's impacts to seagrass, coral reef, and mangrove habitat. We also believe that the EIS significantly underestimates the level of mitigation required to compensate for the project's effects. The EIS omits significant input that NMFS has provided and does not address questions that NMFS has raised.

Please see the attached NMFS letter for a full description of NOAA's concerns. Please direct any questions you have regarding these comments to Ms. Jocelyn Karazsia or Ms. Kelly Logan. Ms. Karazsia may be reached at:

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West Palm Beach, Florida 33401  
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Ms. Logan may be reached at:

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263 13<sup>th</sup> Avenue South  
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Sincerely,

Patricia A. Montanio  
NOAA NEPA Coordinator

Enclosures



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**UNITED STATES DEPARTMENT OF COMMERCE**

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F/SER4:JK/pw

**AUG 12 2013**

Colonel Alan Dodd, Commander  
U.S. Army Corps of Engineers, Jacksonville District  
PO Box 4970  
Jacksonville, Florida 32232

Dear Colonel Dodd:

NOAA's National Marine Fisheries Service (NMFS) has reviewed the draft Environmental Impact Statement (EIS) dated June 14, 2013, entitled *Navigation Improvements, Port Everglades Harbor, Broward County, Florida*. The overall purpose of the project is to provide increased navigational safety, efficiency, and improved economic conditions while limiting impacts to the environment to the maximum extent practical. The U.S. Army Corps of Engineers (USACE) is the lead federal agency and Broward County is the non-federal cost sharing partner for the project. The draft EIS describes a tentatively selected plan (TSP) that includes deepening the Outer Entrance Channel (OEC) to -57 feet mean lower low water (MLLW), widening the OEC to 800 feet, and extending the channel seaward 2,200 feet; deepening the main turning basin to -50 feet MLLW and extending the southeastern boundary of the turning basin an additional 300 feet; widening and deepening the south access channel; and deepening the turning notch (following local sponsor dredging of the same area). Blasting may be needed to remove rocky substrate. Dredge disposal would occur at the existing Port Everglades Harbor Ocean Dredged Material Disposal Site (ODMDS). The draft EIS states the TSP would impact 4.01 acres of seagrass, 15.17 acres of coral reef, and 1.16 acres of mangrove habitat. As detailed below, NMFS believes the draft EIS significantly understates these impacts. These comments reflect the responsibilities of the NMFS under the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act), Fish and Wildlife Coordination Act, and Endangered Species Act (ESA).

### **Service as a Cooperating Agency in Development of the EIS**

By letter dated October 12, 2007, NMFS accepted the invitation from the USACE to participate as a cooperating agency in development of the EIS. In that letter, NMFS stated it would provide technical assistance on how impacts to threatened and endangered species and to essential fish habitat (EFH) would be identified and mitigated. However, NMFS does not have a NOAA federal action that requires us to adopt the EIS for our purposes (such as issuing an MMPA incidental take authorization).

While this is the third version of the EIS NMFS has reviewed, the draft EIS omits significant input NMFS has provided and does not address questions NMFS has raised. Attachment 1 is the detailed review NMFS provided USACE on July 7, 2011. In lieu of repeating the same comments in this letter, NMFS will focus on the major issues that have not been adequately



addressed in the draft EIS, including comments on calculation of impacts to coral reefs, characterization of indirect effects to coral reefs, calculation of seagrass impacts, and seagrass mitigation.

As a cooperating agency, NMFS has responded to requests from the USACE for technical assistance during development of the EIS, including preparation of a report, *Characterization of Essential Fish Habitat in the Port Everglades Expansion Area*, which is draft EIS Appendix H and is part of USACE's EFH assessment, and development of a compensatory mitigation plan for coral reefs that is technically sound and appropriately offsets the impacts to coral reef habitats through active propagation and outplanting of corals. USACE included this mitigation option in the draft EIS as Appendix E-4. In this regard, NMFS also prepared sections of the draft EIS and appendices that describe this mitigation alternative. Lastly, due to the USACE's reluctance to calculate coral reef impacts in the manner NMFS recommended in its comments on earlier versions of the draft EIS, NMFS completed a GIS analysis and technical report characterizing and quantifying the coral reef impacts that would result from the project (Attachment 2).

While NMFS remains hopeful an agreement can be reached on those issues affecting NOAA trust resources, if NMFS and USACE cannot agree on a mutually acceptable mitigation plan to be incorporated in the final EIS, NMFS is considering exercising the option under Section 50 CFR 600.920(k) to refer disputes to the Assistant Secretary of the Army. Further, NMFS may also evaluate the option of referring the matter to the President's Council on Environmental Quality pursuant to Part 1504 of regulations for implementation of the National Environmental Policy Act.

## **Characterization of Coral Reef Impacts**

### Calculation of Direct Impacts to Coral Reef Habitat

NMFS and Nova Southeastern University completed a GIS analysis and characterized the coral reef impacts that would result from the Port Everglades Expansion Project and concluded 21.66 acres of coral reef located in the federal channel will be severely impacted by the planned expansion (Attachment 2). This estimate of direct impacts is approximately 6.49 acres more than the estimate in the draft EIS. The USACE's estimate of direct impacts to coral reef habitats is based only on removal by the dredge and is estimated to total approximately 15.17 acres. Coral reef communities in the channel would be directly impacted through (1) removal by the dredge; (2) coral fragments and dredged material, including rubble and sediments, moving downslope or down current and shearing coral reef organisms from the substrate; and (3) fractures in hardbottom and lithified coral propagating into the reef framework, thereby destabilizing attachment of coral reef organisms. The latter two impacts create an unstable coral reef environment resulting in lower coral abundance and fewer large coral colonies. The steeply sloped, eastward facing spur-and-groove reef habitats are particularly at risk from the downslope movement of sediment and rubble. Stabilizing the seafloor following the dredging at Port Everglades may be the most significant measure that could minimize post-injury impacts on the surrounding reef communities and newly established reef organisms on uncovered substrate (Dial Cordy and Associates 2006); however, such stabilization is not proposed in the draft EIS.

#### Calculation of Potential Impact from Anchor Placement Outside the Channel

Depending on the type of dredge selected, anchoring may be required outside the channel in coral reef and hardbottom habitats. The USACE mitigation plan estimates the anchors would result in approximately 17.13 acres of additional impacts to coral reef and hardbottom habitats. NMFS believes this estimate is too low because the draft EIS uses maps created at a coarse regional scale to calculate the impacts. Brian Walker, Ph.D., of Nova Southeastern University, the cartographer of the maps used by the USACE in the draft EIS, provided NMFS updated acreage calculations based on finer scale maps more suitable for impact assessment at Port Everglades (Attachment 3). NMFS concurs with Dr. Walker's assessment that 19.31 acres (i.e., 2.18 acres more than USACE estimates) of coral reef and hardbottom habitats would be impacted by dredge anchors if this construction strategy is used.

#### Indirect Impacts to Coral Reef Habitat

The draft EIS describes indirect impacts to 130.37 acres of coral and hardbottom habitat within 150 meters of the channel; however, the draft EIS neither describes how this estimate was developed nor the severity of the impacts expected. While NMFS and Dr. Walker estimate 111.87 acres of indirect impacts to coral and hardbottom habitat would result within the 150 meter zone around the channel, NMFS does not agree that sedimentation and turbidity impacts would be limited to this zone. Chronically high levels of sedimentation and turbidity can be as damaging to coral reefs as acute stress (Rogers 1979).

In the July 2011 letter (Attachment 1), NMFS noted that permit SAJ-2003-00203 for the Key West Harbor dredging project included a more stringent turbidity limit (15 Nephelometric Turbidity Units, or NTUs) than what is normally required by the State of Florida. The basis for this requirement was research conducted by Telesnicki and Goldberg (1995) on two Florida coral species (*Dichocoenia stokesii* and *Meandrina meandrites*). The research measured the photosynthetic and respiratory responses of corals subjected in the laboratory to turbidity ranges of 7 to 9, 14 to 16, and 28 to 30 NTU. By day four for *D. stokesii* and day three for *M. meandrites*, corals exposed to 14 to 16 NTU significantly differed from controls. In both cases, this level of turbidity produced a photosynthesis to respiration (P:R) ratio very close to 1.0; the ratio then declined to a ratio of less than 1.0 after six days. The stress from this level of turbidity also induced mucus production. The researchers concluded, "while other species of scleractinians may have different reactions to turbidity, the data suggest that the standard of 29 NTU above background is not conservative and should be reevaluated." These researchers' findings are relevant to the Port Everglades project. Due to the presence of both corals within the project footprint (Dial Cody and Associates 2006), as well as the presence of designated critical habitat for elkhorn and staghorn corals, NMFS continues to recommend a more conservative turbidity standard for the Port Everglades project.

Should blasting be necessary to construct the channel, the draft EIS indicates sedimentation and turbidity monitoring would be done adjacent to the blast sites. NMFS notes conducting monitoring would not avoid or minimize the effects from blasting. The discussion of indirect impacts in the final EIS should provide a more thorough discussion of impacts from blasting that may occur outside the channel, including the size of material produced, amount of material produced, and locations of areas that may require blasting.

### Additional Indirect Impacts to Coral Reef Habitat from Poor Water Quality

The vertical velocity and density structures of the Port Everglades inside channel are stratified and vary depending on the tidal phase (Stamates et al. 2013). The results from the Port Everglades Flow study indicate that it is possible for the upper part of the water column inside the inner entrance channel (the part of the water column most likely to contain excess nutrients and microbial contaminants) to flow in an opposite direction from the lower parts of the water column. Specifically, on the flood tide (as defined from tide tables), the lower part of the inner entrance channel may indeed be flooding but the upper part of the inner entrance channel may remain in ebb for a significant fraction of the time ascribed to the “flood tide.” As stated in sub-appendix C, RMA-2 is a depth-averaged 2D model and will not resolve the vertical features of the channel water column. These features, however, may be important when considering impacts within the vicinity of the inlet.

### **Mitigation for Coral Reef Impacts**

The draft EIS indicates the amount of coral reef mitigation is important to the USACE in determining what the draft EIS refers to as a “best buy” for mitigation and to develop an overall project construction cost. However, NMFS determines the Habitat Equivalency Analysis (HEA) presented in the draft EIS is flawed due to the input of assumptions that are not supported by the best available science. The amount of coral reef mitigation in the form of boulder piles is significantly underestimated and subsequently the costs for coral reef mitigation are also significantly underestimated. Replicating the approach presented in the draft EIS with more realistic assumptions for the HEA results in a mitigation requirement of an additional 32 acres (approximately 51 acres total) of boulder piles needed to offset impacts to coral reef habitats at an additional cost of \$51M above the cost estimate the USACE developed (approximately \$71M total).

The four main areas of disagreement with the way the HEA was used to determine the amount of mitigation are (1) amount of coral reef habitat to be impacted (described in the previous section), (2) equivalence of the impact area to the compensatory action, (3) recovery rate of the mitigation action, and (4) discount rate applied. Additionally, NMFS disagrees with the estimated costs for boulder pile construction, which is a major factor in the determination of a mitigation option as a “best buy.” Furthermore NMFS believes the creation of boulder piles will not adequately mitigate for lost critical habitat for elkhorn coral and staghorn coral.

NMFS notes the independent technical reviews completed by Battelle Memorial Institute (Battelle 2011) for the USACE conclude that some assumptions made for the HEA are either unsupported or have not been clearly justified. Furthermore, a replication of the HEA and technical review of the USACE “best buy” mitigation plan was completed by an internationally recognized coral reef scientist, Richard E. Dodge, Ph.D, Dean of the Nova Southeastern University Oceanographic Center, and provided to NMFS on July 15, 2013 (Attachment 4). NMFS scientists have reviewed the HEA performed by Dr. Dodge and affirm its accuracy. The analyses of Dr. Dodge, Battelle (2011), and NMFS arrive at nearly identical conclusions

regarding the deficiencies in the HEA performed by USACE. Those deficiencies are described below.

#### Inadequacy of Boulder Piles as Mitigation

The HEA presented in the draft EIS assumes 100 percent equivalency between the coral reefs that would be impacted and the boulder piles created for mitigation. This is not supported by the best available science. For example, Miller et al. (2009) documented an overall lack of similarity between the benthic species at natural and artificial reefs. Gilliam (2012) concluded the length of time boulder reefs require to mitigate lost reef resources in southeast Florida exceeds the age of the oldest boulder reef examined in the study (17 years). Kilfoyle et al. (2013) showed nearshore natural and artificial hardbottom habitats have dissimilar usage by the early life stages of species managed under the fishery management plan for snappers and groupers with significantly higher abundances occurring on natural nearshore hardbottoms compared to artificial habitat. Battelle (2011) arrives at a similar conclusion. In particular, the USACE's independent panel review panel expressed concern about the efficacy of mitigation boulders. A pile of boulders is not a coral reef and will not become a coral reef over time, and NMFS disagrees with USACE's determination that boulder piles are in-kind mitigation for coral reef habitat.

Ultimately, the boulders would provide a lower degree of ecosystem services compared to those of a natural coral reef. Battelle (2011) also concludes that some of the assumptions made for the HEA, especially regarding recovery service levels, have not been clearly presented or justified. Specifically, this report states that the assumed 100 percent recovery service level could be overly optimistic. The report acknowledges these values are critical to the HEA and significantly affect the outcomes for the required reef mitigation (Battelle 2011). In the separate analysis performed by Dr. Richard E. Dodge (Attachment 4), an alternative approach to determine equivalency of boulder piles and natural coral reefs is identified. This approach describes an assumption that upon maturity boulders would provide a fraction of the services of the natural reefs (services from structure). This approach is described in Attachment 4 and assumes (for purposes of illustration only) that the artificial reef will provide 50 percent of the services of a natural reef. Both Dr. Dodge and NMFS believe that 50 percent is overly optimistic and not based on the best available science. NMFS believes boulder placement should not be credited with any mitigation value beyond those services provided by the structural components of the reef which the boulders would replace.

The USACE's choice of mitigation is boulder placement with coral transplants. These measures will not provide services upon maturity equivalent to those of the natural reef. Information in the draft EIS states that the recovery rate of boulder piles is 50 years, whereas the cost estimate (draft EIS, Appendix E2) assumes 30 years. The USACE subtracted 20 years from the recovery rate as credit for the coral relocation to the boulder reefs. NMFS acknowledges the Port Everglades Reef Group (2004) discussed allowing a 10-year discount for relocated corals; however, this estimate does not reflect the amount of corals to be relocated by the USACE as project minimization, and this discussion occurred prior to the publication of the USACE and U.S. Environmental Protection Agency's (EPA) Mitigation Rule in 2008.

According to the draft EIS Appendix E2, the total number of corals to be dredged is 100,744. The draft EIS cost estimate indicates up to 12,235 corals would be removed. This would represent a 12 percent reduction in impact and therefore it is not appropriate to credit the boulder reef recovery by 20 years. Furthermore, NMFS does not support crediting the recovery of boulder reefs that have coral transplants, because the transplants are a project minimization measure, not a compensatory mitigation measure. The USACE and EPA's Mitigation Rule (2008) and the Clean Water Act 404(b)(1) Guidelines emphasize that mitigation is sequential: first avoid, then minimize, then perform mitigation for unavoidable impacts. The Mitigation Rule specifically states that compensatory mitigation is only for impacts that cannot be avoided or minimized (Federal Register, Volume 73, Number 70, page 19596, April 10, 2008). This impact minimization measure should be reflected in a corresponding reduction in compensatory mitigation requirements. Thus, it would not be appropriate to also give compensatory mitigation credit to the boulder reef recovery areas that will receive these same coral transplants. This amounts to asking for "credit" twice for the same action. NMFS confirmed this is an accurate interpretation of the Mitigation Rule with EPA headquarters staff via email on July 31, 2013.

Additionally NMFS does not support limiting the amount of relocation to 12,235 coral colonies. Rather, NMFS recommended that USACE establish a performance goal for the relocations of 90 percent for the coral species and size classes presented in Table 2 of the "NOAA Mitigation Alternative," which is located in draft EIS Appendix E-4.

Furthermore, NMFS agrees with the findings of Battelle (2011) that the USACE recovery projection is overly optimistic. In particular, Battelle expressed concern about the unsupported assumptions used in the HEA model analysis. Battelle notes the coral growth rate of *Siderastrea radians* does not support the assumption of the 50-year reef recovery projection. With the given 1.5 millimeters per year growth rate, it will take about 167 years, rather than 50 years, for this coral species to reach 25 centimeters (Battelle 2011). Separately, a NMFS analysis using the very high growth rate of 5 millimeters per year for stony corals suggests that numerous coral species would have a recovery period in excess of 50 years, and likely significantly longer considering the widespread coral recruitment failure documented in the Atlantic and Caribbean (Hughes and Tanner 2000; Williams et al. 2008).

#### HEA/Resource Equivalency Analysis and the Discount Rate

HEA/Resource Equivalency Analysis (REA) is an economic model. While NMFS agrees that HEA and REA are appropriate models to scale the mitigation requirements in some cases, NMFS notes the HEA is applied by the USACE in a manner in which it was never intended for use. Specifically, USACE applies a zero percent discount rate. A zero percent discount rate means the value of environmental services provided today is the same as the value of environmental services provided 1,000 or more years from now. A zero percent discount rate is contrary to the nearly universally accepted theory that there is a time rate of preference for goods of any kind, material or environmental. HEA is an economic model and is not designed to be used with a zero discount rate.

The application of a zero percent discount rate also significantly affects the mitigation requirement when the HEA presented in the draft EIS assumes the impact areas will recover in

50 years. The draft EIS acknowledges some coral reef habitat will only achieve 15 percent of natural reef services but the draft EIS stops the calculation clock at 50 years. If discounting were in place, this would not affect the mitigation requirement much; however, with a zero percent discount rate, continuing these losses beyond 50 years would result in a significant increase in mitigation requirements. While NMFS is aware the draft EIS stops at 50 years because that is the “project life,” this is another example of HEA being applied in a manner inconsistent with its designed application.

The draft EIS states that USACE is prohibited from applying a discount rate due to guidance provided in the Office of Management and Budget Circulars A-4 and A-94 (Regulatory Analysis and Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs, respectively). NMFS disagrees with the USACE’s interpretation of the Circulars. Specifically, Circular A-94 states, “Specifically exempted from the scope of this Circular are decisions concerning water resource projects (guidance for which is the approved Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies).” The Port Everglades Navigation Improvements study and all its components are water resource development projects exempt from Circular A-94. USACE Guidance Documents available for FY12 appear to indicate the USACE should use a discount rate of 4 percent for planning projects<sup>1</sup>.

#### Cost of Boulder Piles

The mitigation plan states the cost per acre ranges from approximately \$1M to \$1.8M among the four alternatives identified in the plan. However, the draft EIS lists the cost to construct boulder piles in previously permitted artificial reef sites or borrow sites as \$588,524 per acre in Table 8 and the cost per acre of boulder piles placed on top of tires as \$1,225,000. The draft EIS does not make clear why there is so much variation in costs of different mitigation alternatives describing a similar action. NMFS agrees with Dr. Dodge’s assessment (Appendix 4) that the \$1.2M estimate per acre is a more appropriate cost. NMFS further notes that the HEA inputs and results in Appendix E2 of the draft EIS are not the same as those of the Cost Analysis.

#### Boulder Piles and *Acropora* Critical Habitat

NMFS and USACE have held multiple meetings and conference calls regarding the effects to *Acropora* critical habitat from this project. NMFS remains concerned that the USACE has not adequately addressed the direct, indirect, and cumulative effects on critical habitat from this project. Further, the draft EIS does not explain how the boulder reef mitigation plan would compensate for loss of critical habitat. NMFS does not believe that a boulder reef would satisfactorily address the lost functions and values of critical habitat within the project area over the lifetime of the project. Despite numerous discussions with the USACE on this subject, NMFS remains concerned that the project as proposed would not adequately preserve and protect designated critical habitat which is necessary for the conservation of the species.

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<sup>1</sup> <http://planning.usace.army.mil/toolbox/library/EGMs/EGM1201combined.pdf>

#### NMFS Recommended Mitigation: Coral Nursery with Outplanting

Considering the unprecedented scale in the southeastern U.S. of the planned coral reef impacts, NMFS presented the USACE with a mitigation plan dated June 7, 2013. The plan consists of propagating corals at one land-based nursery and approximately six nursery sites located offshore of Broward County and then transplanting the reared corals to natural reefs to enhance those reefs or to restore degraded sites. NMFS' recommendation is based on careful evaluation of the expected losses of scleractinian coral and octocorals from the expansion of the Port Everglades OEC and the successes of coral propagation and enhancement programs in Atlantic and Caribbean waters. Because boulder reefs would not adequately offset the functions and values of the reef system which will be impacted as part of the Port expansion project, NMFS recommends this alternative approach using propagation. Furthermore, the NMFS recommended mitigation program is more cost efficient than the USACE "best buy" based on the replicated HEA performed by Dr. Dodge and validated by NMFS.

#### **Elkhorn and Staghorn Coral and Their Designated Critical Habitat**

NMFS continues to have significant concerns with the project's impacts to resources protected under the ESA. The most significant impacts are to critical habitat for threatened elkhorn coral (*Acropora palmata*) and staghorn coral (*Acropora cervicornis*). In 2008, NMFS designated critical habitat for these species to support a single, key conservation objective of increasing the frequency of successful sexual and asexual reproduction: staghorn and elkhorn coral reproduce sexually via broadcast spawning and asexually via fragmentation. The essential habitat feature to accomplish this objective is substrate of suitable quality and availability to support successful larval settlement, recruitment, and reattachment of fragments. NMFS defined "substrate of suitable quality and availability" as "natural consolidated hard substrate or dead coral skeleton that is free from fleshy or turf macroalgae cover and sediment cover" (73 FR 72210).<sup>2</sup> The coral reefs offshore Broward County provide suitable substrate for meeting this key conservation objective.

NMFS believes the draft EIS does not adequately assess the project's impacts to *Acropora* critical habitat. The USACE's analysis of impacts needs to focus on the project impacts on the overall ability of the critical habitat to meet the key conservation objective of supporting successful reproduction. NMFS recommends the analysis address three key issues in this assessment:

- 1) the direct and indirect impacts to coral reef habitat containing the essential feature,
- 2) hydrographic changes from the project and their effect on coral reproduction, and
- 3) beneficial impacts, if any, of the selected mitigation plan to the extent the mitigation plan is included in the USACE's proposed action.

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<sup>2</sup> The draft EIS incorrectly characterizes the essential feature of *Acropora* critical habitat and references the status review which is not an appropriate reference for critical habitat. The final EIS should reference the critical habitat rule directly to accurately describe critical habitat.

In addition to the comments above on the project's impacts to reef areas, NMFS recommends the USACE provide a more complete characterization of the reef habitats associated with the project. Certain types of turf algae will still allow for settlement by *Acropora* larvae. Although the draft EIS states that NMFS has failed to provide a standard protocol for assessing critical habitat, assessing the amount of "substrate of suitable quality and availability" is a basic benthic type characterization which NMFS believes does not require any additional protocol. Even though these direct and indirect impacts lend themselves to expression as areas, the assessment of critical habitat impacts should not be limited to simple area comparisons of the percentage of the entire critical habitat unit being impacted. The analysis should be based on the conservation function lost.

The potential for the widening and deepening of the Port Everglades OEC to affect the functioning of critical habitat through physical changes in the bottom and in local currents remains a major concern. In the 2011 letter, NMFS requested the draft EIS evaluate the potential impacts of creating a "sink" or trench where coral fragments and larvae moving northward or southward along the reef line fall into the channel and become no longer viable. This type of impact not only affects the species directly, it also affects the adjacent critical habitat's ability to support the species. NMFS believes the draft EIS does not adequately respond to these concerns. The draft EIS states multiple times that the currents in the Port Everglades location are "highly unpredictable." The draft EIS discusses the natural reef breaks located in areas between Port of Miami and Port Everglades channels and specifically points out the width of these natural breaks, noting that they are much wider than the proposed cut as part of the Port Everglades channel expansion. However, there is no discussion in the DEIS concerning the depth of these natural breaks and the velocity of the currents through them. NMFS believes that a deeper, narrower "break" would produce a higher velocity current perpendicular to the natural south-north transport of larvae -- and possibly fragment -- transport resulting in the larvae/fragments being washed out of the natural transport pathway, preventing them from landing on suitable substrate, thereby reducing the species' reproductive success and the value of the critical habitat. Because of the need to fully understand impacts, the relative comparison to natural reef breaks is not illuminating. NMFS recommends the USACE provide a detailed hydrographic assessment of the predicted current flow changes post-construction.

The effects of the mitigation plan on the value of *Acropora* critical habitat also needs to be fully analyzed and included in the record of decision for the proposed project. As previously stated, NMFS does not believe the boulder reef mitigation alternative would replace the functions and values of critical habitat lost within the project area over the lifetime of the project. The NMFS recommended mitigation of coral nurseries with outplanting, however, could have significant beneficial impacts on the function of critical habitat. With proper design and operation, this mitigation method could create increased incidences of successful fertilization and fragmentation on both sides of the Port Everglades OEC and increase the conservation function of critical habitat in the vicinity of the project. The USACE needs to fully analyze the net impacts of the project, including the selected mitigation plan, on designated critical habitat, not only to do a thorough comparison of alternatives, but also to ensure the project does not destroy or adversely modify critical habitat, as required by the ESA.

## Underestimate of Seagrass Impacts

The draft EIS describes how seagrass beds, in particular *Halodule wrightii*, *Halophila decipiens*, and *Halophila johnsonii*, expand and contract over time. The seagrass survey data from seven seagrass survey events illustrate this point and are described in Appendix H. In particular, the draft EIS points out this expansion and contraction may be a long-term survival strategy of *H. johnsonii* and other seagrass species (Virmstein et al. 2009). For impact assessment purposes, it is important to consider the broader seagrass habitat and not just the currently vegetated portions. However, the draft EIS describes impacts to seagrass based only on the vegetated portions of the beds documented in the 2009 survey. The draft EIS does not describe impacts to areas historically mapped and previously ground-truthed to contain seagrass. These areas represent the available expansion habitat that will no longer be available after the project is constructed. NMFS believes USACE significantly underestimates the amount of seagrass that would be impacted.

A GIS analysis was used to examine the changes in seagrass coverage between 2000 and 2009. NMFS determined that the cumulative seagrass habitat documented in these seven surveys is approximately 19.45 acres (draft EIS Appendix H), and approximately 8.45 acres of seagrass habitat impacts are proposed<sup>3</sup>. This impact estimate is more than double the seagrass impact described in the draft EIS.

Battelle (2011) also recommended USACE complete a bathymetric survey to identify the extent of potentially suitable seagrass habitat (the report used the more general term submerged aquatic vegetation or SAV). The specific water depths recommended were 0.0 feet to -6.0 feet NGVD. This survey would provide a more complete assessment of seagrass habitat versus seagrass acreage that could then be used as a baseline reference for future seagrass mapping and permitting activities since seagrass bed distribution can vary greatly at any point of time. Fully addressing this recommendation would contribute to resolving concerns NMFS has with the underestimate of seagrass impacts. In the review of a preliminary version of the EIS (Attachment 1), NMFS recommended the draft EIS clearly describe where seagrass impacts would occur and the amount of seagrass habitat present in these areas. The draft EIS does not address this comment.

## Seagrass Mitigation

### West Lake Park Seagrass Mitigation Credits

The restoration planned to be performed by Broward County at West Lake Park is proposed for use as compensatory mitigation for seagrass impacts associated with the port expansion. However, the restoration was not set up as a mitigation bank when NMFS completed its EFH review of the restoration work under SAJ-2002-0072 (IP-LAO). According to the ledger contained in this permit (Attachment 5), there are 2.2 seagrass credits available at West Lake Park. The USACE mitigation plan describes the need to use 2.4 seagrass credits. Using the

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<sup>3</sup> NMFS requires the GIS shapefiles for the revised TSP in order to refine this estimate.

impact estimate that includes 8.45 acres of historically mapped and ground-truthed seagrass habitats and the Unified Mitigation Assessment Method (UMAM) scores applied by the USACE (which are in dispute per the section below), over 5 seagrass credits would be needed from West Lake Park. Thus, using either impact assessment, there are not enough seagrass credits available at West Lake Park.

#### Low Unified Mitigation Assessment Method Scores

Florida's UMAM was the type of functional assessment used to determine the mitigation amount and the USACE acknowledges in their permit that, "USACE UMAM scores on this project were done separately from those submitted by the applicant in conjunction with South Florida Water Management District, future scoring should be done in line with those values which can be found in the file." In July 2011 (Attachment 1), NMFS requested the functional assessments. The draft EIS does not contain the UMAM score sheets for the impacts or the mitigation so NMFS cannot verify the scoring was done in accordance with the permit. A summary table of the UMAM completed for the impacts is provided in the USACE mitigation plan. Notably, 14 out of the 16 seagrass polygons assessed were given a score of 4 or less (out of 10) by the USACE, which corresponds to the habitat providing "minimal level of support to [benthic community] functions" (Form 62-345.900(2), F.A.C.). Five of the 16 seagrass polygons scored 1 or 2 for benthic community. These scores do not reflect NMFS field observations. Additionally, the USACE did not assign higher landscape support functions to seagrass habitats closer to the inlet and clear oceanic waters. The seagrass UMAM scores also do not reflect the best available science or agency input that was obtained from the USACE in 2005 (Attachment 6).

#### Inadequacy of Seagrass Habitat Mitigation at West Lake Park

Another issue previously raised by NMFS (Attachment 1) relates to the location of the mitigation site with respect to the impacts. While it may be appropriate to mitigate for seagrass impacts along the south access channel in West Lake Park, seagrass habitats located closer to the Port Everglades Inlet provide different functions than seagrass habitats located in more interior areas of the Port. The seagrass habitats at West Lake Park, which is located further away from the inlet and coral reefs, would not provide the same ecological services as the seagrass impacted through the expansion.

The proximity of seagrass to the Port Everglades Inlet increases the value of the seagrass habitats located near the inlet for oceanic and estuarine spawners. Habitat value during growth to maturity for gray snapper (*Lutjanus griseus*) and bluestriped grunt (*Haemulon sciurus*) is a function of distance from an ocean inlet (Faunce and Serafy 2007). For example, the planktonic larvae of gag grouper (*Mycteroperca microlepis*) move into estuaries and settle in the first available habitat, such as polyhaline seagrass beds near inlets (Ross and Moser 1995). Based on work completed in the Indian River Lagoon, Gilmore (1995) determined that seagrass habitats near ocean inlets offer optimum physical conditions with low variation in temperature and salinity and other physical parameters, as well as proximity to ocean spawning sites for reef species. Seagrass habitats near inlets typically provide habitat for more fishery species than seagrass away from inlets. A faunal transition and fish community change takes place within 5 km (3.1 miles) of the ocean inlet to the lagoon as one proceeds away from the inlet (Gilmore 1995). Other studies (e.g., Bushon 2006; Turtora and Schotman 2010) have also linked species

distribution and life history stages as a function of proximity to a coastal inlet. The continuity of the seagrass beds between the mitigation site and the inlet is important to fishery species. The proposed port modifications would further isolate seagrass beds at West Lake Park from the inlet, limiting their value in larval migrations and settlement. Accordingly, NMFS believes the UMAM scores for the West Lake Park seagrass should be lower than what the USACE has provided.

## **Cumulative Impacts**

### Coral Reefs and Hardbottoms

As described in Attachment 3, the draft EIS minimizes previous losses of hardbottom due to port construction activities by equating the proposed impacted amount to a percent of all the hardbottom located offshore Broward County. Equating the project impacts to a percent gives the appearance that impacts would be much less. The actual habitat loss is more relevant. Walker et al. (2012) published a peer-reviewed paper on the estimated historical losses of port and shipping activities in southeast Florida. They estimated that Port Everglades has historically dredged 58.5 acres of hardbottom and buried 178 acres of Outer Reef due to improper dumping of spoil material. Using county-wide mean coral density (2.6 per square meter) and percent cover (3.75 percent), Port Everglades development has historically impacted 6,149,000 corals equating to 180 acres of live tissue area. Using these same numbers and the impact scenarios presented in the draft EIS, scenario 1 (includes anchoring impacts outside the federal channel) would impact 380,000 corals with 1.36 acres of live cover, and scenario 2 (dredging coral reefs above -57 feet MLW and no anchoring impacts) would impact 177,000 corals with 0.63 acres of live cover.

The draft EIS does not describe any cumulative impacts for hardbottom. Although the effect of impacting six million corals is difficult to measure, it undoubtedly has some impact on surrounding communities. In addition, the burial of 178 acres of Outer Reef due to improper spoil disposal has a lasting effect on the system. This spoil remains in place today where rocks of all sizes are piled on the reef. These spoils likely shift during storms and continually impact the local community by scouring the substrate as evident in the Dial Cordy and Associates (2009) benthic assessment of previously impacted sites.

### Water Quality

NMFS disagrees with the USACE determination that water quality impacts would only be temporary due to construction activities, and the project would not result in any foreseeable future actions that would result in a cumulative effect. On the ebb tide, water is advected seaward through the Port Everglades inner entrance channel. Several studies of this inlet have shown this water contains higher concentrations of nutrients and microbial contaminants compared to levels typically seen in the coastal ocean (Stamates et al. 2013; Futch et al. 2011). These substances have the potential to degrade the coastal environment. Enlargement of the channel brings the possibility of increasing the flux of these substances out of the inlet and into the coastal ocean.

## Endangered Species Act Section 7 Consultation

NMFS continues to work with the USACE to obtain all the information necessary to conduct a Section 7 consultation for ESA-listed species and critical habitat under NMFS purview. Two comments on critical habitat are offered at this time. First, the draft EIS concludes that adverse effects to *Acropora cervicornis* and designated critical habitat from increased sedimentation would be insignificant. NMFS agrees that the findings and evidence reported in the paragraphs preceding that statement may support this finding for the species. However, it provides no basis for the determination about sediment effects to critical habitat. To evaluate that effect, the USACE would need to provide documentation regarding the duration of sediment residence (dependent on grain size and physical oceanography of the area) on adjacent hardbottoms (i.e., the essential feature) to be able to say the effect is insignificant for designated critical habitat. Second, NMFS requests clarification of the following point made in the draft EIS, “hardbottom communities exist in a dynamic environment . . . may be periodically covered and uncovered by sands.” NMFS requests a reference for this statement and the periodicity that is being referred to.

## Essential Fish Habitat Consultation

As a cooperating agency, NMFS prepared *Characterization of Essential Fish Habitat in the Port Everglades Expansion Area*, which is included in the draft EIS Appendix H. This report describes the EFH and fishery resources in the project area and summarizes the biological resource surveys that have been completed. For complete descriptions of EFH in the project area, NMFS refers to this report. The main categories of EFH and HAPC that would be adversely affected by this project include coral, coral reef, and hardbottom; seagrass; mangrove; the coastal inlet; and unvegetated soft bottom habitats.

The report requires the addition of a section characterizing the existing channel bottom due to review of a video from October 18, 2006, that documents corals in the existing channel bottom. Notably, this video confirms the presence of corals that not only are EFH but also proposed to be listed by NMFS under the ESA, including rough cactus coral (*Mycetophyllia ferox*).

### Impacts to Essential Fish Habitat

The USACE provided an initial determination that the project may adversely affect EFH and HAPCs. The USACE determined the magnitude of the impacts varies from temporary and insignificant to substantial and permanent. NMFS believes the impacts of the proposed project, along with project components that have been removed from the federal project but are still being pursued by the Port (i.e., dredging 8.4 acres of mangrove to expand a turning notch), result in more adverse impacts to EFH than what are described in the draft EIS, questioning USACE’s conclusion that the project’s cumulative impacts are negligible.

### Essential Fish Habitat Assessment Information Needs

NMFS has considerable disagreement with the USACE on how seagrass and coral reef impacts and mitigation requirements have been determined. NMFS also has significant disagreement with the USACE on how water quality degradation and cumulative impacts are described in the

draft EIS. These issues are identified in the preceding and warrant thorough consideration prior to completing the EFH consultation for this project.

## **EFH Recommendations**

NMFS finds the project would adversely impact EFH. Section 305(b)(4)(A) of the Magnuson-Stevens Act requires NMFS to provide EFH conservation recommendations when an activity is expected to adversely impact EFH. Based on this requirement, NMFS provides the following:

### **EFH Conservation Recommendations**

Prior to dredging seagrass or coral reef and hardbottom habitat to expand the Port Everglades Harbor, NMFS recommends the following:

1. The USACE shall provide a mitigation plan that assumes no less than 21.66 acres of direct impacts to coral reef and hardbottom habitats.
2. The USACE shall provide a mitigation plan that assumes no less than 19.31 acres of anchor impacts, in the case that the dredge equipment selected requires anchoring outside the federal channel.
3. The USACE shall provide a monitoring plan to evaluate physical and biological impacts that may occur outside the channel. This plan shall reflect substantial input by NMFS.
4. The USACE shall provide a mitigation plan that reflects no less than 111.87 acres of indirect impacts that would occur in the 150 meter zone surrounding the federal channel. The final EIS should clearly describe how the amounts of indirect impacts to coral reefs are determined.
5. In the case that blasting is required, USACE shall work with NMFS and other resource trustees to develop a monitoring program. Substantial input from NMFS shall be reflected in the final blasting monitoring plan.
6. The USACE shall update the HEA with scientifically defensible inputs on equivalency of natural coral reefs and boulder piles, recovery rates of dredged coral reef habitat, recovery rates of boulder piles, and discount rates. The final HEA shall reflect actual costs of boulder piles with substantial input from NMFS.
7. The USACE shall adopt a compensatory mitigation plan that is the most technically sound approach to offsetting the loss of coral, coral reef, and hardbottom habitat. The final coral reef mitigation plan shall not take credit twice for coral relocation. The final coral reef mitigation plan shall reflect input from NMFS.
8. As a project minimization measure, the USACE shall relocate all corals in accordance to Table 2 in the draft EIS Appendix E-4. Coral relocation shall occur in expansion areas and previously dredged areas. The coral relocation plan should include clearly defined performance standards, monitoring protocols, and schedule.
9. The USACE shall update the EIS to evaluate the potential for the deepening and widening of the OEC to create a "sink" or trench whereby coral fragments and larvae moving northward or southward along the reef line fall into the channel and become no longer viable. This update to the EIS shall reflect significant input from NMFS.
10. The USACE shall update the EIS to describe no less than 8.45 acres of seagrass habitat impacts. The EIS shall be updated to include historically mapped and ground-truthed

seagrass habitat areas that would be eliminated by dredging and no longer available as contraction and expansion habitat.

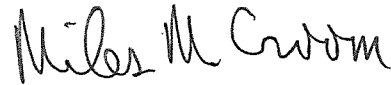
11. The USACE shall update the EIS to describe indirect impacts to seagrass habitat. This update shall reflect input from NMFS. Specifically, NMFS requests USACE update the EIS to identify each seagrass impact polygon on a map and provide a narrative that explains how the impact area was calculated for each seagrass impact area.
12. The USACE shall develop supplementary compensatory mitigation for seagrass impacts to account for the loss of all seagrass habitat that has been historically mapped and ground-truthed and will become unavailable as habitat after the dredging occurs. The additional mitigation shall appropriately address seagrass impacts that occur closer to or within the inlet. The plan shall address how the site selection for mitigation locations is supported by the best available literature. This plan should include clearly defined performance standards, monitoring protocols, and schedule. The mitigation amounts shall be based on a functional assessment that reflects NMFS and other resource trustee input.
13. The USACE shall update the cumulative impacts section and description of cumulative impacts to coral reefs and water quality. The EIS should be updated to acknowledge the findings of Walker et al. (2012) that Port Everglades has historically dredged 58.5 acres of hardbottom and buried 178 acres of Outer Reef as dredged material disposal, which resulted in the loss of over six million corals and approximately 180 acres of live coral tissue area.
14. The USACE shall require use of best management practices (BMP) to avoid and minimize the degradation of water quality and minimize impacts to hardbottoms and seagrass habitat, including the use of staked turbidity curtains around the work areas, marking of seagrass and hardbottom habitat to facilitate avoidance during construction, and prohibiting staging, anchoring, mooring, and spudding of work barges and other associated vessels over seagrass and hardbottom. These BMPs shall be coordinated with NMFS for approval prior to commencement of any work.

Section 305(b)(4)(B) of the Magnuson-Stevens Act and implementing regulation at 50 CFR Section 600.920(k) requires the USACE to provide a written response to this letter within 30 days of its receipt. If it is not possible to provide a substantive response within 30 days, in accordance with NMFS's "findings" with the USACE Jacksonville District, an interim response should be provided to NMFS. A detailed response must then be provided prior to final approval of the action. The detailed response must include a description of measures proposed by the USACE to avoid, mitigate, or offset the adverse impacts of the activity. If USACE's response is inconsistent with the EFH conservation recommendations, the USACE must provide a substantive discussion justifying the reasons for not following the recommendation.

Thank you for the opportunity to provide comments. Related questions or comments should be directed to the attention of Pace Wilber, Ph.D., or Ms. Cathy Tortorici. Dr. Wilber can be reached at 219 Fort Johnson Road, Charleston, SC, 29412, by telephone at 843-762-8601, or by e-mail at

Pace.Wilber@noaa.gov. Ms. Tortorici can be reached at the letterhead address. Ms. Tortorici may also be reached by telephone at 727-209-5953 or by e-mail at Cathy.Tortorici@noaa.gov.

Sincerely,



Roy E. Crabtree, Ph.D.  
Regional Administrator

Enclosures: Attachment 1: NMFS comments, dated July 11, 2011, on interim draft EIS  
Attachment 2: Acreage analysis by NMFS  
Attachment 3: Acreage analysis by Dr. Brian Walker, July 15, 2013  
Attachment 4: HEA review by Dr. Richard Dodge, July 21, 2013  
Attachment 5: West Lake Park mitigation credit ledger  
Attachment 6: USACE UMAM scores

cc:

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**UNITED STATES DEPARTMENT OF COMMERCE**  
**National Oceanic and Atmospheric Administration**  
NATIONAL MARINE FISHERIES SERVICE

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JUL 7 2011

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Colonel Alfred Pantano  
District Engineer, Jacksonville District  
Department of the Army Corps of Engineers  
PO Box 4970  
Jacksonville, Florida 32232

Dear Colonel Pantano:

NOAA's National Marine Fisheries Service (NMFS) has reviewed the interim Draft Environmental Impact Statement (EIS), dated May 31, 2011, titled *Navigation Improvements, Port Everglades Harbor Broward County, Florida*, prepared by the U.S. Army Corps of Engineers, Jacksonville District (COE). This is the second version of the interim Draft EIS that the COE has asked NMFS to review as a cooperating agency under the National Environmental Policy Act. The higher priority issues NMFS has identified regarding the proposed work are discussed below so they may be resolved before a Draft EIS is released to the public. Other important issues and information needed for the essential fish habitat (EFH) and Endangered Species Act consultations are described in the matrix format requested by the COE (enclosed). Our comments reflect NMFS' responsibilities under the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act), Fish and Wildlife Coordination Act, and Endangered Species Act (ESA).

By letter dated October 12, 2007, NMFS accepted the COE's invitation to participate as a cooperating agency in development of the EIS for the expansion of Port Everglades. In this letter, NMFS stated that as a cooperating agency we would provide technical assistance on how impacts to threatened and endangered species and to EFH should be identified and mitigated. However, in the years since we began working with the COE as a cooperating agency, NMFS has experienced considerable difficulty in having our input substantively incorporated into the resulting NEPA documents. To illustrate this point, fewer than 20% (33 out of 180) of the comments NMFS provided on the 2008 version of the interim Draft EIS are fully addressed in this latest version. NMFS invested significant time in the earlier review and, as a cooperating agency, we are disappointed that so few of our recommendations have been adopted to date. While we remain hopeful that we can reach agreement on those issues affecting NMFS trust resources, NMFS feels obliged to inform the COE that if NMFS' comments and recommendations are not adequately resolved in the forthcoming Draft EIS, NMFS will consider the option of referring the matter to the Council on Environmental Quality.



## **Coral Reef Impact Assessment: ESA-listed species, Compensatory Mitigation, Terminology, and Contingency Planning**

Calculation of Coral Reef Impacts. The interim Draft EIS does not describe how impacts to coral reefs were determined. Dr. Brian Walker (Walker *et al.*, 2008b) concludes there would be 20.34 acres of direct impact to coral reefs; however, the interim Draft EIS describes 15.34 acres of direct impact to coral reefs. In June 2008, the COE informed NMFS that coral reefs located deeper than 56 feet<sup>1</sup> but still within the proposed expansion to the federal channel would be considered indirect impacts. NMFS assumes this approach by the COE results in the different total for impact acreage, but we cannot verify this because the impacts are not precisely described in the interim Draft EIS. For each coral reef impact area, please identify the impact polygon on a map and provide a narrative that explains how the impact area was calculated. Also, please provide a detailed description of the source of each direct and indirect impact. For example, coral reefs located within the federal channel that are not dredged but are immediately adjacent to the dredging would be severely and permanently injured through the physical processes of rubble movement and scour. This impact is not discussed in the interim Draft EIS and should not be lumped into a discussion of impacts from turbidity and sedimentation, which may be as severe and permanent by occurring through a different mechanism. However, the physical impact to coral reef structure and the biological response to these types of impacts would be different. This detail is needed in the EIS, and similar detail is missing for indirect and direct impacts from anchoring and vessel operations.

Acroporid species (elkhorn and staghorn coral) and their designated critical habitat. NMFS has significant concerns with the proposed widening and deepening of the Outer Entrance Channel (OEC). These impacts constitute new dredging that would permanently remove portions of the Middle and Outer Reef. According to the interim Draft EIS, approximately 15.35 acres of coral reef habitat would be directly and permanently impacted by dredging and 91.29 acres of coral reef habitat may be indirectly impacted (note that these estimates do not include the potential for additional reef impacts from the anchors and cables needed for operation of a cutterhead dredge). This coral reef habitat is designated as an EFH-Habitat Area of Particular Concern (HAPC) under the Magnuson-Stevens Act and as critical habitat designated under the ESA for threatened elkhorn coral (*Acropora palmata*) and staghorn coral (*Acropora cervicornis*)<sup>2</sup>.

In 2008, NMFS determined that the key conservation objective for threatened elkhorn and staghorn corals is increasing the frequency of successful sexual and asexual reproduction; staghorn and elkhorn coral reproduce sexually via broadcast spawning and asexually via fragmentation. To accomplish this objective, NMFS determined that conservation of substrate of suitable quality and availability to support successful larval settlement, recruitment, and reattachment of fragments was needed. NMFS defined "substrate of suitable quality and availability" as "natural consolidated hard substrate or dead coral skeleton that is free from fleshy or turf macroalgae cover and sediment cover" (73 FR 72210). The coral reefs offshore from Broward County provide suitable substrate for meeting the key conservation objective.

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<sup>1</sup> The EIS states that the Tentatively Selected Plan would dredge to -57 feet (pg 37).

<sup>2</sup> Due to time constraints, NMFS Protected Resources Division was not able to review the *Acropora* spp. survey report. We will review this document during ESA Section 7 consultation.

NMFS requests that the EIS evaluate the potential for the deeper and wider OEC to serve as a “sink” or trench whereby coral fragments moving northward or southward along the reef line fall into the channel and become no longer viable. The proposed action may exacerbate the “sink” effect by dredging through the middle and outer reefs, thereby cutting off the continuity of the reef and potentially impeding successful asexual reproduction (Ken Banks, Ph.D., Broward County, pers. comm., June 23, 2011).

Based on the information provided, NMFS believes the proposed action would undermine the key conservation objective (i.e., facilitating successful reproduction) and potentially hinder the recovery of threatened corals. Consequently, the proposed action is likely to adversely modify designated critical habitat for elkhorn and staghorn coral. NMFS will evaluate potential effects from the proposed project on elkhorn and staghorn coral and their designated critical habitat in our biological opinion. The loss of elkhorn and staghorn coral critical habitat due to the proposed action would be permanent and would not be offset by any form of mitigation. NMFS requests an analysis to determine how this potential “sink” effect (basically separating the critical habitat) would affect the critical habitat’s ability to conserve the species.

Effects of turbidity and sedimentation on corals. The analysis presented in Section 4.5.14.22 needs to be updated with additional literature from locally relevant studies. The interim Draft EIS states “a review of four [dredging] projects [in south Florida, including the Florida Keys] found that using Best Management Practices for turbidity and sedimentation control (e.g., ceasing dredging when turbidity levels exceed permitted standards) are protective of the coral and hardground environments surrounding south Florida sand borrow sites and navigation channels.” NMFS notes that permit SAJ-2003-00203 for the Key West harbor dredging project includes a more stringent turbidity limit (15 Nephelometric Turbidity Units, or NTUs) than what is normally required by the State of Florida. The basis for this requirement was research conducted by Telesnicki and Goldberg (2005) on two Florida coral species (*Dichocoenia stokesii* and *Meandrina meandrites*) that measured the photosynthetic and respiratory responses of corals subjected in the laboratory to turbidity ranges of 7 to 9, 14 to 16, and 28 to 30 NTU. By day four for *D. stokesii* and day three for *M. meandrites*, corals exposed to 14 to 16 NTU significantly differed from controls. In both cases, this level of turbidity produced a photosynthesis to respiration (P:R) ratio very close to 1.0; the ratio then declined to a ratio of less than 1.0 after six days. The stress from this level of turbidity also induced mucus production. The researchers concluded “while other species of scleractinians may have different reactions to turbidity, our data suggest that the standard of 29 NTU above background is not conservative and should be re-evaluated.” These researchers’ findings are relevant to the Port Everglades project. Due to the presence of both corals within the project footprint (DCA 2006; NMFS 2011), NMFS believes that a more conservative turbidity standard is warranted for the Port Everglades project and other dredge and fill projects in southeast Florida that occur in close proximity to coral reefs. Furthermore, the most recent and most local (Broward County) sedimentation study (Jordan et al. 2010) is not referenced in the interim Draft EIS. Jordan et al. (2010) concluded that sampling stations within close proximity to dredging in sand borrow areas exhibited higher collection rates and lower percent fines when compared to control stations. A thorough review of sedimentation effects on corals is also provided in this paper. NMFS recommends that the findings from Jordan et al. (2010), be summarized in this discussion as well.

Additionally, in this section of the interim Draft EIS, several unsubstantiated statements are made that should be removed unless supported by citation. For example, the interim Draft EIS states “the examples of adverse effects of turbidity and sedimentation on coral species often cited by resource managers are commonly projects in third world countries without the strict water quality protections that are in place in the U.S.” No studies are referenced to support this statement. The interim Draft EIS further states that these water quality protections are also protective of coral species, including *Acropora spp.* and its designated critical habitat, located near dredging operations. This statement should be supported by an appropriate reference.

NMFS believes the interim Draft EIS does not accurately characterize the results of Rogers (1983). While this reference is not provided in the literature cited, NMFS presumes the reference is to work in Puerto Rico where the sublethal and lethal effects of sedimentation were examined on five Caribbean coral species, including elkhorn coral and staghorn coral. Rogers (1983) found that elkhorn coral was the least tolerant of the species tested. Immediately after a single application of sediments (200 mg per square cm), the three elkhorn coral colonies released fine strands of mucus. After 6 days, algae were already growing on the smothered portions, both on the bleached sections of the corals and on the sediment accumulations. These colonies never recovered. While elkhorn coral was found to be the least tolerant of the species Rogers tested, staghorn coral fared better, presumably due to its cylindrical branches and almost spherical morphology. NMFS believes it is misleading to combine elkhorn and staghorn coral when discussing sedimentation effects. In addition to discussing the effects of sedimentation on staghorn coral, the interim Draft EIS should mention the less favorable results of Rogers’ experiments on the more sensitive elkhorn coral.

Coral reef mitigation. The mitigation proposed to offset the coral reef impacts is insufficient. While the deployment of boulder piles has been a practice in southeast Florida for coastal construction projects authorized by the Jacksonville District, there are no studies available that show that the creation of boulder piles can return ecological services similar to those that would be lost due to dredging the Middle and Outer Reefs. Considering the unprecedented scale of the planned coral reef impacts, NMFS believes the COE should invest additional effort in working with coral reef stakeholders to develop a mitigation plan that could adequately offset the magnitude and extent of coral reef impacts that would result from this project. NMFS is aware of several coral reef restoration and enhancement opportunities that may be relevant; for example, coral reef enhancement and restoration through tire removal<sup>3</sup>, water quality improvements<sup>4</sup>, creation of a coral nursery and outplanting, restoration of orphaned grounding or anchor drag sites, or a combination of these activities. NMFS encourages the COE to collect the necessary information beyond what has been collected to date by other agencies or universities to pursue these opportunities further.

A scientifically sound mitigation plan should be developed with substantive input from resource trustees. The plan should clearly document though appropriate use of functional assessments and analytic tools (e.g., Habitat Equivalency Analysis and Florida’s Unified Mitigation Assessment Method) that the injuries to the coral reef framework and biological communities would be offset

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<sup>3</sup> This mitigation option was vetted through the Port Everglades Reef Group during 2002-2005 (DCA 2005)

<sup>4</sup> This mitigation option was vetted through the Port Everglades Reef Group during 2002-2005 (DCA 2005)

through the compensatory action(s). The plan should also be developed to ensure that appropriate coral species and size classes are scalable to the amount and type of coral reef mitigation that is planned (see NMFS 2011, Section 6.4). Furthermore, the mitigation plan should describe how the work would fully adhere to the Council on Environmental Quality's Appropriate Use of Mitigation and Monitoring Guidance (CEQ 2011) and the Army Corps of Engineers and Environmental Protection Agency's mitigation rule (33 CFR Parts 325 and 332/40 CFR Part 230).

Sea turtles and coral reefs. In addition to being an EFH-HAPC and designated critical habitat for elkhorn and staghorn coral, the coral reefs offshore from Broward County provide foraging and resting habitat for sea turtles that are listed under the ESA. Coral reefs are widely recognized as the resident foraging habitat of juvenile, subadult, and adult hawksbill sea turtles (*Eretmochelys imbricate*) (NMFS and FWS 1993). NMFS also recognized the importance of coral reefs as resting and foraging grounds for loggerhead sea turtles (*Caretta caretta*) (NMFS and FWS 2008). In the second revision to the Recovery Plan for the Northwest Atlantic Population of the Loggerhead Sea Turtle, NMFS states that the "negative impacts of dredging include destruction or degradation of habitat and incidental mortality of sea turtles" (NMFS and USFWS 2008). The proposed action would adversely affect foraging and resting habitat for loggerhead and hawksbill sea turtles. NMFS requests an analysis of how the proposed work (i.e., the permanent removal of coral reef habitat) may affect the various life stages of hawksbill and loggerhead sea turtles that are associated with coral reefs.

Coral reef terminology. Consistency is needed on how coral reefs are referenced in the EIS. In some instances, as many as nine different terms are used to describe the same feature. For example, for the feature NMFS refers to as the "Outer Reef," the EIS refers to this as: outer terrace (pg 102), outer tract (pg 142), third reef (pg 166), outer reef (pg 38), third outer reef (pg 31), Terrace 3 (pg 102), coral reef (page 193), hardbottom and reef communities (page 144), and low relief and high relief hardbottom (pg 145). Calling the same feature many different names is not technically correct and is confusing to the reader. NMFS recommends using the habitat classifications tied with the development of the coral reef maps. This is further supported by the terminology described in Moyer et al. (2003); Banks et al. (2007); Walker et al. (2008a); Walker et al. (2008b); and Collier et al (2008). These peer-reviewed publications should be the basis for the terminology.

The need for a contingency plan to adaptively respond to unauthorized coral reef impacts. As evidenced in the Key West channel dredging project (2004 to 2005), dredges can drift outside of the channel and damage sensitive benthic resources. In this case, the hopper dredge drifted outside of the channel limits, and the drag arm damaged NOAA trust resources within the NOAA Florida Keys National Marine Sanctuary in the Sanctuary. Due to the possibility of human error and the presence of coral reef communities immediately adjacent to the Port Everglades channel, it would be prudent to develop a contingency plan to avoid or minimize damage to NOAA's trust resources should an incident transpire similar to what occurred in Key West. The commitment to develop such a plan should be provided in the EIS.

## **Seagrass Impact Assessment and Compensatory Mitigation**

Seagrass habitat area and calculation of seagrass impacts. NMFS (2011) used survey data from 2001, 2006, and 2009 to determine there are 19.45 acres of seagrass habitat in the project area (i.e., the project footprint and adjacent areas). A cumulative analysis of these seagrass surveys to yield the amount of seagrass habitat is supported by the best available scientific information on the biology of seagrass species present in the Port Everglades area. For example, Virmstein et al. (2009) concludes that the expansion and contraction of seagrass beds, also referred to as “pulsating patches” may be a long-term survival strategy of *Halophila johnsonii*. Summary information on the best available science on this issue can be found in NMFS 2011 (Section 2.1.1).

The interim Draft EIS does not clearly describe how the COE determined that the extent of impacts to seagrass habitat is 4.01 acres. Based on the results described in NMFS (2001), we believe that the interim Draft EIS substantially underestimates the amount of seagrass habitat that would be impacted through the planned dredging. Furthermore, seagrass habitats documented in the Outer Entrance Channel (1.04 acres) and indirect impacts to seagrass are not quantified or considered as environmental consequences. For each seagrass impact area, please identify the impact polygon on a map and provide a narrative that explains how the impact area was calculated. The impact amounts should be based on cumulative seagrass area. Please also provide a detailed description of the type of direct and indirect impact. For this purpose, please also include an evaluation of seagrass impacts that would result from the equilibration of channel side slopes. The EIS should clearly describe where these impacts will occur and how much seagrass is present in these areas.

Seagrass mitigation. The restoration planned to be performed by Broward County at West Lake Park is proposed for use as compensatory mitigation for seagrass and mangrove impacts associated with the Port expansion. However, the restoration was not set up as a permittee-responsible mitigation area (PROMA) or other type of mitigation bank when NMFS completed its EFH review of the restoration work under SAJ-2002-0072 (IP-LAO)<sup>5</sup>. A mitigation banking instrument or PROMA instrument should be developed and coordinated with NMFS for review and approval. At a minimum, the PROMA instrument should describe the available credits<sup>6</sup>, how they were determined, and the credit release schedule. In addition, NMFS requests to be provided the results from a functional assessment that shows the habitats impacted in order to complete the restoration work to demonstrate that impacts have been adequately mitigated and any other habitat tradeoffs in EFH will result in a net benefit to fishery resources.

Furthermore, seagrass habitats located closer to the Port Everglades Inlet likely provide different functions than seagrass habitats located in more interior areas of the Port. The seagrass habitats at West Lake Park, which is located further away from the inlet and coral reefs, would not

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<sup>5</sup> Special condition 16 of the permit authorized by the Jacksonville District for West Lake Park acknowledges that the restoration work may be used as compensatory mitigation for Broward County projects. Special condition 17 describes how mitigation credits could be accounted for through post-restoration monitoring and permit modification.

<sup>6</sup> The South Florida Water Management District determined that 2.2 functional credits are available at West Lake Park, however the EIS Executive Summary (page iv) states that 3 functional units from West Lake Park would be needed. In contrast, the Mitigation Plan (page 11) states that 1 functional unit would be needed.

provide the same ecological services as the seagrass impacted through the expansion. This issue should be examined in the Draft EIS and through a functional assessment.

### **Alternatives and Objectives**

The 2008 version of the interim Draft EIS did not identify objectives of the feasibility study. When NMFS agreed to participate as a cooperating agency, the COE stated the purpose of the project was to (1) evaluate potential project designs to provide increased safety, (2) enable efficiency and lower costs for future port navigation and utilization, and (3) protect the environment to the maximum extent practical while meeting the stated goals of the feasibility study. The current version of the interim Draft EIS presents revised objectives that include (1) decrease costs associated with vessel delays from congestion, channel passing restrictions, and berth deficiencies at Port Everglades, (2) decrease transportation costs through increasing economies of scale for cargo and petroleum vessels at Port Everglades, and (3) increase channel safety and maneuverability at Port Everglades for existing vessel use as well as for larger vessels, through the year 2067. Notably, the commitment to environmental protection is missing from the revised project objectives.

The 2008 version of the interim Draft EIS evaluates seven alternatives, whereas the current version thoroughly reviews only two alternatives, the Tentatively Selected Plan (TSP) and the No Action Alternative. Five alternatives were not thoroughly reviewed in the current version of the interim Draft EIS and now are proposed for elimination. This approach does not present a full, balanced review of alternatives. For example, the interim Draft EIS only presents disadvantages associated with the Lightering Alternative and concludes that lightering is not under the jurisdiction of the District, yet this alternative is not included in Section 2.6: Alternatives not within the jurisdiction of the lead agency.

An additional example is from statements provided to justify elimination of the Offshore Petroleum Alternative from further examination. The interim Draft EIS says the COE was unable to identify a pipeline route and a deepwater anchorage area that would avoid coral reef and hardbottom habitats, but there is no discussion of how the U.S. Maritime Administration was able to identify such areas in their EIS for the nearby Calypso Deepwater Port. The interim Draft EIS also inaccurately characterizes other issues with this alternative as intractable, when in fact they were resolved in the Calypso project, e.g., constructing the pipeline in the Navy exclusion area and increasing congestion and traffic were resolved in this particular example.

In response to our review of the 2008 version of the interim Draft EIS, NMFS recommended the COE fully evaluate an alternative or combination of alternatives that evaluates the potential to install a NOAA National Ocean Service Physical Oceanographic Real Time System (PORTS), a modified version of PORTS, or other current tracking system. In response to this, the COE indicates they will not consider a PORTS alternative and they cite information on the ineffectiveness of an Acoustic Doppler Current Profiler in the entrance channel (which alone does not constitute a PORTS). In the past, the COE has cited discussions with pilots and real time data issues; however, discussions NOAA staff has had with the pilots do not corroborate the elimination of a PORTS for this reason. NMFS continues to recommend the COE fully evaluate a PORTS as an alternative and in combination with other alternatives.

Further, the interim Draft EIS states that “should any of the cooperating agencies choose to provide a detailed analysis of any of these alternatives for incorporation into the EIS, they are invited and encouraged to do so.” This was not presented to cooperating agencies as an expectation when we agreed to serve in this capacity, nor were we aware that the project objectives and resulting elimination of alternatives would change so drastically that this might be necessary. Considering the expedited schedule for moving forward with the interim Draft EIS and due to staffing and funding constraints, NMFS is not prepared to perform as a cooperating agency in this capacity.

### **EFH Assessment**

The information provided in the interim Draft EIS does not meet the requirements of the EFH provisions of the Magnuson-Stevens Act. While the COE may choose to integrate the required components of an EFH Assessment into various parts of the EIS, the various components of the interim Draft EIS as presented do not meet the requirements of 50 CFR 600.920(e)(3) and (4). NMFS would like to work with the COE to ensure that the requirements found at 50 CFR 600.920(e)(3) and (4) are included in the Draft EIS. Notably missing are items that pertain to the analysis of the potential adverse effects of the action on EFH and the managed species, the COE’s conclusions regarding the effects of the action on EFH, and details regarding proposed mitigation. In addition, pertinent literature is missing from the interim Draft EIS (see the literature cited for this letter and in NMFS 2011). Also a thorough analysis of alternatives to the proposed action is missing (see section above).

### **Endangered Species Act Section 7 Consultation**

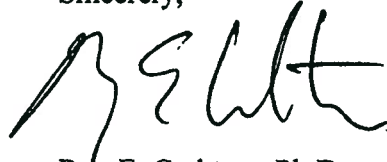
There are numerous references in the interim Draft EIS to NMFS’ opinion concerning how the proposed work may affect listed species and critical habitat under our purview. In our previous review of the 2008 interim Draft EIS, NMFS asked the COE to remove “placeholders” that were included in the document referencing NMFS’ concurrence or NMFS’ biological opinion concerning this project. To date, NMFS has not received all of the information needed to evaluate potential effects of the proposed work on listed species and critical habitat under our purview; therefore, it is inappropriate and incorrect to reference NMFS’ opinion in a public document given that we have not even received all of the information needed for our analysis. NMFS reiterates our request that such references to “NMFS’ concurrence” and “NMFS’ biological opinion” be removed from the EIS until those are obtained.

### **Closing**

In view of the expectation that the EIS will be released to the public in January 2012, NMFS hopes the COE will soon propose a schedule to coordinate with us to fully address all of the above listed items, in addition to the other important issues identified in the enclosed matrix. Please direct inquiries and correspondence related to the EFH consultation under the Magnuson-Stevens Act to the attention of Ms. Jocelyn Karazsia at (561) 616-8880, extension 207, or [Jocelyn.Karazsia@noaa.gov](mailto:Jocelyn.Karazsia@noaa.gov). For further endangered and threatened species

coordination on this project, please contact Audra Livergood at (954) 356-7100 or at Audra.Livergood@noaa.gov.

Sincerely,



Roy E. Crabtree, Ph.D.  
Regional Administrator

Enclosures: Additional SERO comments on the EIS

cc:

F/SER3, David Bernhart, Audra Livergood  
F/SER, David Keys, Noah Silverman  
F/SER4, Miles Croom, David Dale  
F/SER47, Jocelyn Karazsia

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**NOAA NMFS PRD Comments**  
**Interim DEIS**  
**(VERSION 2: July 7, 2011)**  
**PORT EVERGLADES FEASIBILITY STUDY DRAFT EIS**  
**COMMENTS REVIEW MATRIX**

**These comments supplement the issues addressed in our letter dated July 7, 2011**

AGENCY	COMMENT No.	SECTION/ PAGE/Line	COMMENTOR/ OFFICE	COMMENT	RESPONSE
NMFS SERO				It remains difficult for NMFS to fulfill our responsibility as a cooperating agency (or the intent of 40 CFR 1501.6 and 1508.5) due to the District's reluctance to substantively address the comments we provided during our review of the initial EIS in March 2008. To illustrate this point, less than 20% (approximately 33 out of 180) of our comments are fully addressed in the latest version of the EIS. NMFS invested considerable time in the 2008 review and in this review, and as a cooperating agency, we fully expect the District to carefully consider our comments and recommendations. In this regard, please address all the comments listed below, in addition to the comments we provided in March 2008. The latter set of comments is not re-stated here.	
NMFS PRD			Livergood/PRD	NMFS recommends that the dredge contractor and associated personnel participate in a resource awareness training prior to commencement of construction. We envision training similar to the training required for the Broward County Shore Protection Project (Segment III). The COE may wish to consider this type of training as a Conservation Measure that would potentially benefit ESA-listed species and other NMFS' trust resources.	
NMFS PRD		Exec Summ/iv/3	Livergood/PRD	DEIS states, "Pre-treatment of rock substrates may be necessary. Appropriate measures to safeguard protected species during this process will be undertaken." This is vague. Please elaborate on what is meant by "appropriate measures to safeguard protected species."	
NMFS PRD		Exec Summ/iv/21	Livergood/PRD	An up-to-date estimate (based on 2009 survey data) of the total acreage of areas that contain <i>H. johnsonii</i> (i.e., Seagrass Assessment Areas 2, 4, and 5, based on 2009 survey data). For the purposes of quantifying adverse effects on <i>H. johnsonii</i> , NMFS requests that the impact estimate be based on implementation of the Recommended Alternative, as described in the DEIS.	

COMMENTS REVIEW MATRIX, *cont'd.*

NMFS PRD		Exec Summ/iv/23	Livergood/PRD	<p>PRD has significant concerns with the proposed widening and lengthening of the Outer Entrance Channel. These impacts constitute new dredging that will permanently remove portions of the middle and outer reef. According to the DEIS, approximately 15.35 acres of coral reef habitat would be directly impacted (i.e., permanently removed) by dredging and 91.29 acres of coral reef may be indirectly impacted (note that these estimates do not include the potential for additional reef impacts associated with anchor/cable placement from a cutterhead dredge). This coral reef habitat is both EFH-HAPC and designated critical habitat for threatened elkhorn coral (<i>Acropora palmata</i>) and staghorn coral (<i>Acropora cervicornis</i>).</p> <p>In 2008, NMFS determined that the key conservation objective for threatened elkhorn and staghorn corals is facilitating increased incidence of successful sexual and asexual reproduction. In order to facilitate increased incidence of successful reproduction, NMFS determined that the feature essential to the conservation of these species is substrate of suitable quality and availability to support successful larval settlement, recruitment, and reattachment of fragments. NMFS defined "substrate of suitable quality and availability" as "natural consolidated hard substrate or dead coral skeleton that is free from fleshy or turf macroalgae cover and sediment cover" (73 FR 72210). The coral reefs offshore from Broward County, Florida, provide suitable substrate necessary to meet the key conservation objective of facilitating increased incidence of successful sexual and asexual reproduction. Therefore, these reefs provide the feature essential to the conservation of threatened elkhorn and staghorn coral. Staghorn and elkhorn coral can reproduce sexually (via broadcast spawning) and asexually (via fragmentation). Perhaps the Port Everglades entrance channel acts a "sink" or trench whereby coral fragments attempting to migrate north or south along the contiguous linear reef fall into the channel and are no longer viable (Dr. Ken Banks, Broward County, pers. comm., 6-23-11). The proposed action may exacerbate the "sink" effect by dredging through the middle and outer reefs, thereby cutting off the continuity of the reef and potentially impeding successful asexual reproduction. Hence, the proposed action undermines the key conservation objective (i.e., facilitating successful reproduction) and potentially hinders the recovery of these threatened corals. Based on the preceding, the proposed action is likely to adversely affect designated critical habitat for elkhorn and staghorn coral. NMFS will evaluate potential effects from the</p>	
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**COMMENTS REVIEW MATRIX, *cont'd.***

				proposed project on elkhorn and staghorn coral and their designated critical habitat in our biological opinion. The loss of elkhorn and staghorn coral critical habitat due to the proposed action would be permanent and would not be offset by any form of mitigation. NMFS requests an analysis to determine how this potential “sink” effect (basically separating the critical habitat) would affect the critical habitat’s ability to conserve the species.	
NMFS PRD		Exec Summ/iv/23	Livernood/PRD	DEIS states the proposed work includes the removal of 15.35 acres of hardbottom and reef habitats. Coral reefs are widely recognized as the resident foraging habitat of juvenile, subadult, and adult hawksbill sea turtles <sup>1</sup> . NMFS also recognized the importance of coral reefs as resting and foraging grounds for loggerhead sea turtles <sup>2</sup> . In the second revision to the Recovery Plan for the Northwest Atlantic Population of the Loggerhead Sea Turtle ( <i>Caretta caretta</i> ), NMFS states that the “negative impacts of dredging include destruction or degradation of habitat and incidental mortality of sea turtles” (NMFS and USFWS 2008). The proposed action would adversely affect foraging and resting habitat for loggerhead and hawksbill sea turtles. NMFS requests an analysis of how the proposed work (i.e., the permanent removal of coral reef habitat) may affect the various life stages of hawksbill and loggerhead sea turtles that are associated with coral reefs.	

<sup>1</sup> National Marine Fisheries Service and U.S. Fish and Wildlife Service. 1993. Recovery Plan for Hawksbill Turtles in the U.S. Caribbean Sea, Atlantic Ocean, and Gulf of Mexico. National Marine Fisheries Service, St. Petersburg, Florida.

<sup>2</sup> National Marine Fisheries Service and U.S. Fish and Wildlife Service. 2008. Recovery Plan for the Northwest Atlantic Population of the Loggerhead Sea Turtle (*Caretta caretta*) Second Revision. National Marine Fisheries Service, Silver Spring, Maryland.

**COMMENTS REVIEW MATRIX, *cont'd.***

NMFS PRD		Exec Summ/iv/28 & 29	Livergood/PRD	DEIS states, "No direct impacts to protected species are anticipated." However, line 21 states, "unavoidable impacts include removal of 3.6 acres of protected Johnson's seagrass." Johnson's seagrass is a threatened species, protected under the ESA, and it would be directly impacted by proposed dredging. NMFS disagrees with the statement that no direct impacts to protected species are anticipated. We suggest deleting "no direct impacts to protected species are anticipated."	
NMFS PRD		Exec Summ/iv/30	Livergood/PRD	DEIS states, "the West Indian manatee population may have less forage available due to removal of seagrasses." NMFS notes that adult green sea turtles, protected under the ESA, also forage on seagrasses and may be indirectly affected due to loss of foraging habitat.	
NMFS PRD		Exec Summ/iv/30 & 31	Livergood/PRD	DEIS states, "No long-term impacts to water quality are anticipated due to turbidity monitoring and dredge shut-down protocols." Please specify what is the trigger for a dredge shut down for this particular project.	
NMFS PRD		Exec Summ/iv/34-36	Livergood/PRD	DEIS states, "USACE has proposed the following: (a) mitigate for the removal of 4.01 acres of seagrass and (b) the loss of 1.16 acres of mangroves in the project footprint (including within the channel and resulting side slopes) through use of an ongoing habitat improvement project at West Lake Park." The text "including within the channel and resulting side slopes" seems to refer to mangroves, but presumably this text should refer to seagrass impacts. Suggest moving this text up so it reads "(a) mitigate for the removal of 4.01 acres of seagrass (including within the channel and resulting side slopes)..."	
NMFS PRD		Exec Summ/iv/41-44	Livergood/PRD	As per the DEIS, USACE proposes to mitigate for the loss of approximately 15.35 acres of coral reef habitat by creating 16.74 acres of high-profile artificial reef habitat and 11.39 acres of low-profile hardbottom habitat. NMFS' position is that all 15.35 acres constitutes coral reef habitat (EFH-HAPC) and designated critical habitat for elkhorn and staghorn coral. The loss of approximately 15.35 acres of elkhorn and staghorn coral critical habitat would be permanent and would not be offset by mitigation.	

**COMMENTS REVIEW MATRIX, *cont'd.***

NMFS PRD		2.7/47/10	Livergood/PRD	What is the estimated duration of construction?	
NMFS PRD		2.9.2.1/49/40	Livergood/PRD	In the event that a clamshell dredge is used, will the COE require the contractor to use a sealed (or closed) bucket? A sealed bucket was used during the Key West Harbor dredging project in order to reduce the loss of dredged material from the bucket, thereby reducing turbidity in the water column. NMFS recommends use of a sealed bucket as a best management practice for this project.	
NMFS PRD		2.9.2.1/51/2	Livergood/PRD	DEIS states "Silt curtains may be deployed around the dredge if water quality standards cannot be met using operational controls." NMFS recommends silt curtains not be used in offshore areas where they are ineffective and may damage trust resources if they become detached and mobile.	
NMFS PRD		2.9.2.2/52/49-51	Livergood/PRD	DEIS states "A project-specific biological assessment has been developed for the Port Everglades project that includes the use of a hopper dredge as a construction technique (Appendix F)." NMFS received the biological assessment (BA) in 2004. The BA does not include up-to-date impact estimates for Johnson's seagrass (NMFS 2011 and DCA 2009) nor does it include species listed (elkhorn and staghorn coral) and critical habitat designated (for elkhorn and staghorn coral) since 2004.	
NMFS PRD		2.9.2.2/58/1-15	Livergood/PRD	In the event that a cutterhead dredge is used, will the dredge spud down within the project footprint? Does the COE anticipate spudding impacts to benthic resources located outside of (i.e., adjacent to) the project footprint? NMFS supports the avoidance/minimization measures listed on page 58 of the DEIS (i.e., use of surge buoys and restricted anchor placement).	

**COMMENTS REVIEW MATRIX, *cont'd.***

NMFS PRD		2.9.3.1/64/16-32	Livergood/PRD	DEIS states "The primary environmental impact of spudding or hydrohammer is noise and vibration. This constant pounding would serve to disrupt marine mammal behavior in the area, as well as impact other marine species...Using the punch barge will also extend the length of the project...Punch barging was previously attempted, unsuccessfully, at Port Everglades in 1981...The operation was very noisy and the vibration of the chisel on bottom caused direct impact to nearby structures, including homes (Alan Sosnow, pers. comm.)." Based on the preceding, is the COE eliminating spudding, hydrohammer, and punch barging from further consideration?	
NMFS PRD		2.9.3.2/71/33	Livergood/PRD	DEIS states "Because of the potential duration of the blasting and the proximity of the inshore blasting to a seasonal manatee high use area (Port Everglades FPL discharge canal), a number of issues will need to be addressed." What is the potential duration of the blasting?	
NMFS PRD		2.9.3.2/74/21	Livergood/PRD	Will the contractor be required to do pre-blasting charges (this was done in the Miami Harbor phase II project)?	
NMFS PRD		2.9.5/76-81/35-50 (p.76) and 7-22 (p.79) and 1-17 (p.81)	Livergood/PRD	NMFS understands the purpose of the proposed "environmentally friendly bulkheads" (i.e., to minimize erosion to mangrove habitats from large ship wakes); however, the DEIS lacks sufficient information to fully evaluate potential effects on listed species from the bulkheads themselves and from construction of the bulkheads. For example, will the submerged riprap be placed in water that is less than 1 meter deep? Will the bulkheads be designed with breaks in the riprap that are large enough to permit access by juvenile sawfish? Will the use of barges and/or the proposed piles impact Johnson's seagrass? Will the submerged riprap impact Johnson's seagrass? Will the staging areas impact mangroves? Will the proposed blasting be confined? Will there be a monitoring plan for protected species? Will the proposed dredging for the sideslope excavation impact Johnson's seagrass?	

**COMMENTS REVIEW MATRIX, *cont'd.***

NMFS PRD		3.5.2/87/46	Livergood/PRD	DEIS states that Type 1 mangroves provide “minimal benefits to wildlife or protected species...” What is the basis for this statement? No citation is provided.	
NMFS PRD		3.5.2/88/8-22	Livergood/PRD	Based on reviewing the DEIS and the EFH Assessment (Appendix H), NMFS understands that Mangrove Assessment Area #2 is part of the proposed action. As per the DEIS, Mangrove Assessment Area #2 is comprised of Type 1, 2, 3, and Type 4 mangroves associated with John U. Lloyd State Park (DEIS, pp. 87-88). Red mangroves are present within Type 1-4 mangrove communities (DEIS pp. 87-88). Red mangroves and shallow water less than 1 meter in depth provide habitat for smalltooth sawfish, particularly small and very small juveniles (74 FR 45353). It is unclear whether smalltooth sawfish are able to access red mangrove habitats that fall under Types 3 and 4. Please include a statement in the next version of the DEIS that clarifies whether gaps are currently present in the riprap of adequate size to allow smalltooth sawfish access to Type 3 and 4 mangrove areas. In addition, please include a statement in the next version of the DEIS stating whether shallow water habitat (less than 1 meter in depth) adjacent to red mangroves would be impacted by the proposed action and if impacts are proposed, please quantify impacts to shallow water habitats.	
NMFS PRD		3.6.1.2/94/1	Livergood/PRD	Figure 43 in the DEIS is pulled directly from the EFH Assessment (see Figure 1 in EFH Assessment); however, in Figure 1, the legend is labeled “Seagrass Distribution 2006.” This label was deleted from Figure 43 in the DEIS. It is not clear why the label was deleted. NMFS recommends re-inserting the label so it is clear to the reader that both Figure 43 in the DEIS and Figure 1 in the EFH Assessment depict seagrass distribution in 2006 within the Port Everglades study area.	

**COMMENTS REVIEW MATRIX, *cont'd.***

NMFS PRD		3.6.2/101/42-44	Livergood/PRD	DEIS states, "Three first terrace sites FTL 4, FTL 5, and FTL 6 are known to have unusually high coral cover and FTL 6 is dominated by <i>Acropora cervicornis</i> ." These Broward County monitoring stations are not located on the "first terrace" they are located on the nearshore ridge complex (Ken Banks, Broward County, pers. comm. via e-mail on 6-21-11). "First terrace" should be replaced with "nearshore ridge complex" in the DEIS.	
NMFS PRD		3.7.2.1/109/26-28	Livergood/PRD	DEIS states, "Seagrass surveys conducted for the project (DCA 2000, 2001, and 2006) found that <i>H. johnsonii</i> occurs within the SAC and DCC." NMFS requests that the DEIS be updated to reflect the 2009 survey effort as well as past survey efforts. As per the DCA 2009 survey report, <i>H. johnsonii</i> was also found in the NTB (see Figure 5 in DCA 2009 report).	
NMFS PRD		3.7.2.2/109/40-41	Livergood/PRD	DEIS states smalltooth sawfish were once common in Florida as detailed by the draft Smalltooth Sawfish Recovery Plan (NMFS 2006). Please update the DEIS to reflect the Final Recovery Plan, which was published in the FR on Jan. 21, 2009 and is available at <a href="http://www.nmfs.noaa.gov/pr/pdfs/recovery/smalltoothsawfish.pdf">http://www.nmfs.noaa.gov/pr/pdfs/recovery/smalltoothsawfish.pdf</a>	
NMFS PRD		3.7.2.13/123/42-43	Livergood/PRD	DEIS states, "NMFS PRD leadership agreed that a modified methodology for surveying for <i>Acropora</i> spp. in 13 federal navigation channels within <i>Acropora</i> spp. critical habitat was warranted." NMFS notes that this may have been discussed at a previous meeting but an agreement (such as an MOA) was never made in writing.	
NMFS PRD		3.7.2.13/124/Figure 48	Livergood/PRD	The nearshore ridge complex is notably absent from the <i>Acropora</i> spp. survey area even though the ridge complex contains suitable substrate essential to the conservation of elkhorn and staghorn coral (i.e., the essential feature) and the ridge complex is located north and south of the channel within the 150-meter indirect impact area as shown on Figure 48 in the DEIS. NMFS requests an explanation as to why portions of the nearshore ridge complex located within the indirect impact area were not surveyed for elkhorn and staghorn coral.	
NMFS PRD		4.3.2/142/Table 22	Livergood/PRD	In Table 22, the impact calculation for <i>H. johnsonii</i> (sum of areas containing only H <sub>j</sub> and areas of mixed SAV with H <sub>j</sub> ) is 3.57 acres. Does this calculation reflect the best available information (i.e., the EFH Assessment also referenced as NMFS 2011 and DCA 2009)? Based on the best available information, NMFS believes potential direct effects to <i>H. johnsonii</i> are approximately 4.05 acres. The DEIS should be updated to reflect the best available information.	

COMMENTS REVIEW MATRIX, *cont'd.*

NMFS PRD		4.4.2.2/145/2-3	Livergood/PRD	DEIS states "This hardbottom provides an important habitat for many fish and invertebrate species." In addition to providing habitat for fishes and invertebrates, coral reefs provide foraging and resting habitat for at least two species of sea turtles (hawksbill and loggerhead sea turtles). Juvenile, subadult, and adult hawksbills use coral reefs for foraging and refuge habitat (NMFS 1993). Loggerhead sea turtles are also associated with coral reefs (NMFS and USFWS 2008). Recommend that the DEIS be updated to reflect the importance of coral reef habitat for sea turtles.	
NMFS PRD		4.5.1.3/149/19-21	Livergood/PRD	DEIS states "Dredging would result in the removal of up to 3.57 acres of mixed or monoculture Johnson's seagrass habitat where it occurs along the SAC and Widener." NMFS requests an up-to-date estimate (based on 2009 survey data) of the total acreage of areas that contain <i>H. johnsonii</i> (i.e., Seagrass Assessment Areas 2, 4, and 5, based on 2009 survey data). For the purposes of quantifying adverse effects on <i>H. johnsonii</i> , NMFS requests that the impact estimate be based on implementation of the Recommended Alternative, as described in the DEIS. Based on the best available information (NMFS 2011 and DCA 2009), NMFS believes that the proposed action is likely to adversely affect approximately 4.05 acres of mixed and monoculture <i>H. johnsonii</i> beds. The DEIS should be updated to reflect the best available information.	
NMFS PRD		4.5.1.3/149/22-24	Livergood/PRD	DEIS states "Changes in bottom depth through deepening and widening efforts with the Port may limit the amount of available habitat suitable for Johnson's seagrass recolonization." NMFS concurs and would like to add that deepening beyond 3-4 meters - which is the maximum depth of occurrence observed for <i>H. johnsonii</i> (NMFS 2007, Kenworthy 2000, and Hammerstrom et al. 2006) - is likely to impede post-dredging recolonization of areas that currently support <i>H. johnsonii</i> .	
NMFS PRD		4.5.1.3/149/29-35	Livergood/PRD	DEIS states that the COE's impact estimate for <i>H. johnsonii</i> is based on the analysis contained in their 2004 Biological Assessment (BA), which estimates a maximum impact of 3.57 acres of mixed and monoculture <i>H. johnsonii</i> beds. NMFS notes that both the BA and the impact estimate contained therein are very likely outdated and the estimate should be superseded by the best available information (NMFS 2011 and DCA 2009). Based on the best available information, NMFS believes that the proposed action is likely to adversely affect approximately 4.05 acres of mixed and monoculture <i>H. johnsonii</i> beds. The DEIS should be updated to reflect the best available information.	

**COMMENTS REVIEW MATRIX, *cont'd.***

NMFS PRD		4.5.5.2/154/9-10	Livergood/PRD	The COE's position, as stated in the DEIS, is that the loss of sea turtle foraging habitat from the proposed action would be offset by the proposed mitigation (i.e., creation of artificial reefs). NMFS disagrees with the COE's position. We do not believe that the creation of artificial reefs would offset the permanent loss of foraging and resting habitat for sea turtles.	
NMFS PRD		4.5.5.2/154/35-37	Livergood/PRD	As a Conservation Measure, NMFS recommends that the dredge contractor be required to use shields on offshore dredge equipment lighting. This may help to avoid or reduce the potential for sea turtles to become disoriented.	
NMFS PRD		4.5.8/162/11-15	Livergood/PRD	DEIS states "USACE made a determination that the potential impacts to North Atlantic right whales from the project are so unlikely as to be discountable in the Biological Assessment...Based on this information, NMFS issued a concurrence with USACE's determination of may affect, not likely to adversely affect for the proposed project..." We have two comments. First, we recommend that the text "NMFS issued a concurrence with USACE's determination of may affect, not likely to adversely affect for the proposed project" be deleted based on the fact that NMFS has not issued an opinion for the proposed project. Furthermore, both the 1995 and 1997 South Atlantic Regional Biological Opinions issued by NMFS to the COE for hopper dredging activities (and beach nourishment) from North Carolina through Florida East Coast concluded that increases in vessel traffic associated with hopper dredging is likely to adversely affect right whales and humpback whales. The 1995 BO states, "While dredging itself is not likely to be a problem (for whales), the transit of hopper dredges between borrow, channel, and disposal areas is likely to result in increased vessel traffic in the vicinity of humpback and right whales...ship strikes are one of the primary human-caused sources of mortality for both humpback and right whales, and increased vessel traffic may increase the likelihood of whale/vessel interactions." In the 1995 BO, NMFS concluded that right whales and humpback whales may be adversely affected due to increased vessel traffic associated with hopper dredging and disposal of dredged material, but severe impacts can be avoided through continued cooperation between dredge operators and endangered species observers during the seasons whales may occur in the project area.	

**COMMENTS REVIEW MATRIX, *cont'd.***

NMFS PRD		4.5.10/163/37-39	Livergood/PRD	See previous comment. This same comment applies to humpback whales.	
NMFS PRD		4.5.14.2.2/169/2 7-28	Livergood/PRD	The DEIS (page 169) states that a decision was made in consultation with NMFS not to relocate <i>Acropora</i> spp. colonies if any are identified during pre-construction surveys. We believe this may be a typographical error. NMFS has no recollection or record of agreeing not to relocate <i>Acropora</i> spp. colonies. In fact, this contradicts a previous commitment made by the COE. In a letter dated October 18, 2006, from the COE to NMFS, the COE committed to relocating elkhorn and staghorn coral colonies if such colonies were identified during pre-dredging relocation surveys and reinitiating ESA Section 7 consultation with NMFS (since relocation would constitute take). While we understand that no <i>Acropora</i> spp. colonies have been identified in the direct or indirect impact area to date, it is possible that <i>Acropora</i> spp. colonies exist in the project area and have not been identified by any surveys to date. Therefore, we believe the approach that the COE outlined in their October 18, 2006, is prudent and we consider the COE's commitment to re-locate any <i>A. cervicornis</i> or <i>A. palmata</i> colonies (should any be identified during relocation surveys) to be part of the proposed action.	
NMFS PRD		4.5.14.2.2/169/3 5-37	Livergood/PRD	DEIS states "Although there is published literature concerning the effects of sedimentation and turbidity on coral reefs throughout the world, there is a paucity of peer reviewed published data from many recent dredging events that have taken place in southeast Florida." NMFS recommends the COE support the first part of this statement by citing peer-reviewed, published literature on the known effects of turbidity and sedimentation on corals (e.g., Telesnicki and Goldberg 1995, Rogers 1983 and 1990, Dodge and Vaisnys 1977, Philipp and Fabricius 2002). Furthermore, most of these studies (with the exception of Philipp and Fabricius 2002) examined the effects of sedimentation or turbidity on Caribbean corals and the findings would be relevant for southeast Florida since the species assemblages on Caribbean reefs are similar to those in southeast Florida reefs. Regarding the second part of the statement (i.e., there is a "paucity of peer reviewed published data from many recent dredging events in southeast Florida"), NMFS knows of at least one peer-reviewed study in southeast Florida that examined the effects of sedimentation on adjacent coral reefs in Broward County, Florida (Jordan et al. 2010). In this study, the sedimentation was associated with beach nourishment and dredging activities adjacent to reefs just south of Port Everglades in Segment III. NMFS recommends citing this study in the DEIS.	

**COMMENTS REVIEW MATRIX, *cont'd.***

NMFS PRD		4.5.14.2.2/170/1 6-19	Livergood/PRD	<p>DEIS states “A review of four [dredging] projects [in south Florida, including the Florida Keys] found that using Best Management Practices for turbidity and sedimentation control (e.g., ceasing dredging when turbidity levels exceed permitted standards) are protective of the coral and hardground environments surrounding south Florida sand borrow sites and navigation channels.” NMFS notes that the COE permit for the Key West project included a more stringent turbidity limit (15 NTU) than what is normally required in the state of Florida. The basis for this requirement was research conducted by Telesnicki and Goldberg (1995) on two Florida coral species (<i>Dichocoenia stokesii</i> and <i>Meandrina meandrites</i>). The researchers subjected laboratory corals to turbidity ranges of 7-9, 14-16, and 28-30 NTU and measured the corals’ photosynthetic and respiratory responses. Corals exposed to 14-16 NTU were “significantly different” from controls beginning with day 4 in <i>D. stokesii</i> and day 3 for <i>M. meandrites</i>. In both cases, this level of turbidity produced a P:R ratio very close to 1.0 after 3-4 days and less than 1.0 after 6 days. Mucus production was noticeable at this level (14-16 NTU) of turbidity. The researchers concluded, “While other species of scleractinians may have different reactions to turbidity, our data suggest that the 29 NTU standard is not conservative and should be re-evaluated.” These researchers’ findings are relevant to the Port Everglades project. Due to the presence of corals both within and in close proximity to the project, NMFS believes that a more conservative turbidity standard is warranted for the Port Everglades project and other dredge and fill projects in southeast Florida in close proximity to coral reefs.</p>	
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**COMMENTS REVIEW MATRIX, *cont'd.***

NMFS PRD		4.5.14.2.2/173/1 3-16	Livergood/PRD	Page 173 of the DEIS states, "The examples of adverse effects of turbidity and sedimentation on coral species often cited by resource managers are commonly projects in third world countries without the strict water quality protections that are in place in the U.S." The DEIS further states that these water quality protections are also protective of coral species, including <i>Acropora</i> spp. and its designated critical habitat, located near dredging operations. No citation is provided for this statement. NMFS supports Telesnicki and Goldberg's findings. Specifically, we believe the 29 NTU turbidity standard used in Florida may not adequately protect corals and should be re-examined for dredge and fill projects near coral reefs.	
NMFS PRD		4.5.14.2.2/173/3 7-39	Livergood/PRD	The DEIS mentions Caroline Rogers' work in Puerto Rico. Rogers examined the sublethal and lethal effects of sedimentation on five Caribbean coral species, including elkhorn coral ( <i>Acropora palmata</i> ) and staghorn coral ( <i>Acropora cervicornis</i> ). Rogers found that elkhorn coral was the least tolerant of the species she tested. Immediately after a single application of sediments (200 mg cm <sup>-2</sup> ), the three elkhorn coral colonies released fine strands of mucus. After 6 days, algae were already growing on the smothered portions, both on the bleached sections of the corals and on the sediment accumulations. These colonies never recovered. <sup>3</sup> While elkhorn coral was found to be the least tolerant of the species she tested, staghorn coral fared better, presumably due to its cylindrical branches and almost spherical morphology. NMFS believes it is misleading to lump elkhorn and staghorn coral together when discussing sedimentation effects. In addition to discussing the effects of sedimentation on staghorn coral, the DEIS should mention the less favorable results of Rogers' experiments on the more sensitive elkhorn coral.	
NMFS PRD		4.5.14.2.2/173/4 9-50	Livergood/PRD	DEIS states "we believe adverse effects to <i>A. cervicornis</i> from increased sedimentation will be insignificant. This determination is consistent with NMFS' previous findings in NMFS 2009." The NMFS 2009 citation is missing from the literature cited. It is unclear what document the COE is referencing here. Please add this citation to the literature cited.	

<sup>3</sup> Rogers, C. 1983. Sublethal and Lethal Effects of Sediments Applied to Common Caribbean Reef Corals in the Field. Marine Pollution Bulletin, Vol. 14, No. 10, pp. 378-82.

**COMMENTS REVIEW MATRIX, *cont'd.***

NMFS PRD		4.7/178/14-15	Livergood/PRD	DEIS mentions the Ocean Express Pipeline and the Calypso project in the Cumulative Impacts section. These projects were never constructed and are no longer relevant.	
NMFS PRD		6.2/189/19-24	Livergood/PRD	DEIS states that consultation was initiated with NMFS upon completion and submittal of the Biological Assessment (in 2004). It also references NMFS' biological opinion as an appendix. As previously requested, please remove references to NMFS' biological opinion since NMFS has not yet issued an opinion on this project. In addition, we have not initiated consultation because we do not have all of the information needed to begin consultation.	

COMMENTS REVIEW MATRIX, *cont'd.*

**NOAA NMFS HCD Comments**  
**Interim DEIS**  
**(VERSION 2: July 7, 2011)**  
**PORT EVERGLADES FEASIBILITY STUDY DRAFT EIS**  
**COMMENTS REVIEW MATRIX**

**These comments supplement the issues addressed in our letter dated July 7, 2011**

AGENCY	COMMENT No.	SECTION/ PAGE/Line	COMMENTOR/ OFFICE	COMMENT	RESPONSE
NMFS SERO				It remains difficult for NMFS to fulfill our responsibility as a cooperating agency (or the intent of 40 CFR 1501.6 and 1508.5) due to the District's reluctance to substantively address the comments we provided during our review of the initial EIS in March 2008. To illustrate this point, less than 20% (approximately 33 out of 180) of our comments are fully addressed in the latest version of the EIS. NMFS invested considerable time in the 2008 review and in this review, and as a cooperating agency, we fully expect the District to carefully consider our comments and recommendations. In this regard, please address all the comments listed below, in addition to the comments we provided in March 2008. The latter set of comments is not re-stated here.	
NMFS		Page ii, lines 35-41	HCD	<p>The IDEIS states that USACE will mitigate for the direct removal of 10.37 acres of complex, high-profile, reef habitat through the creation of approximately 16.74 acres of high-profile, artificial reef habitat, and mitigate for the direct removal of 4.97 acres of less complex, low-profile hardbottom habitat by creating 11.39 acres of low-profile hardbottom.</p> <p>The terms "high-profile" and "low-profile," have not been used to characterize the coral reefs in the project area. While we understand CESAJ has used these terms on other projects, they are absent from the best available scientific information that characterize the coral reefs in Florida, therefore CESAJ should not continue to use the terms. There also seems to be an assumption that a low-profile coral reef provides lower ecological services than a high profile coral reef. In the absence of information to justify this, NMFS cannot agree with this assumption.</p>	
NMFS		Page iv, line 5	HCD	It is our understanding that EPA has not yet approved the ODMDS expansion and the existing capacity cannot accommodate this amount of dredge material, therefore statements such as "dredge disposal will occur at the Offshore Dredged Material Disposal Site west of the Port" are pre-decisional and should be removed until a final decision has been made.	
NMFS		Section 1.3, page 18, 31	HCD	This section is helpful in describing the project need for the post-Panamax vessels, however more detail on the next generation of oil tankers and cruise ships expected to call on the Port. Please provide the length,	

**COMMENTS REVIEW MATRIX, *cont'd.***

				<p>breadth, and maximum draft and width of the next generation of oil tankers and cruise ships – similar to what is provided for the cargo containers. Other references are made to the “future design fleet” however the detail on the design is only provided for post-panamax vessels.</p> <p>In section 2.5.2.1 the trucking alternative is eliminated from further consideration partially because of the design consideration of Aframax (deep-draft petroleum vessels) however the design specifications for the new generation of this vessel type that are expected to call on Pt Everglades are not provided. This information is needed for NMFS to fully evaluate the alternatives.</p> <p>(NMFS identified this as a deficiency in our 2008 review of the iDEIS as well)</p>	
NMFS		1.3, page 18	HCD	<p>For data quality purposes a citation should follow the following sentence, otherwise it should be removed: Additionally, NOAA has recognized the unpredictable currents and resultant safety issues at the Port Everglades entrance channel in its annual publication for mariners, “The Coast Pilot”.</p>	
NMFS		Missing from the EIS	HCD	<p>A crucial missing piece of information is how far out into the coastal ocean the ebb tide plume is typically advected. NOAA AOML has some data in hand from the ADCPs they have deployed in shallow water in this area, the flows are about evenly divided between north and south (close to shore). Interestingly, the southern directed flows are often more energetic. CESAJ should fully evaluate and study how the plume behaves once it leaves the channel. In considering the fate of materials introduced into the waters of the Port Everglades channel it should be noted that the flow patterns in the channel during the flood tide and the ebb tide are somewhat different.</p> <p>During ebb tide, flow velocities are sufficiently high in the Port Everglades channel that any materials introduced into the channel will be quickly advected seaward to the coastal waters. Momentum will propel these waters eastward for some distance until the ambient coastal currents redirect the flow to (typically) the north or to the south. (Some preliminary data collected by NOAA AOML in this area suggest that, nearshore, coastal currents are roughly, evenly divided between southern flow and northern flow. Further from shore, the currents are more predominantly northern directed.</p> <p>During the flood tides, near surface (depth &lt; 3m) velocities in the channel are often significantly less than the velocities at deeper depths and in some cases, a weak seaward surface flow persists during the landward flood tide flow at depth. Surface waters therefore, may not be driven inland as might be expect if the flow was not vertically stratified. This condition may allow surface water to accumulate in the basin until the next ebb tide or possibly still be transported seaward during the flood tide.</p>	
NMFS		Section 1.4, Page 21	HCD	<p>The purpose of this Environmental Impact Statement is to “provide full and fair discussions of significant environmental impacts and shall inform decision-makers and the public of the reasonable alternatives that would avoid or minimize adverse impacts or enhance the quality of the human environment” (NEPA</p>	

**COMMENTS REVIEW MATRIX, *cont'd.***

				regulations 40 CFR 1502.1).	
				CESAJ has stated that, as a project sponsor, they are a proponent of the project. It appears that this position has limited the ability of CESAJ to provide "full and fair discussions."	
NMFS		Section 1.5, Related Documents	HCD	The document NMFS HCD prepared is referenced and sections pasted in several section of the document, please add the following citation to the list: NMFS 2011. Characterization of Essential Fish Habitats in the Port Everglades Expansion Area, 45 pp.	
NMFS		Section 1.6, "Study team"	HCD	Less than 20% of the comments NMFS provided in version 1 of the EIS were fully accepted in version 2. Therefore, NMFS feels it is misleading to refer to us as part of a "study team". Several sections of the EIS, i.e., sections that characterize the coral reefs in the project areas and the mitigation plan, would be substantively different if we were actually part of a study team. Please refer to NMFS as a cooperating agency and identify the sideboards of our involvement – i.e., from our October 2007 letter, "providing technical assistance on how impacts to threatened and endangered species and to essential fish habitat (EFH) should be appropriately identified and mitigated". Furthermore, the term "study team" is not used in any section other than this one, therefore there seems to be little value to identifying one.  (NMFS identified this as a deficiency in our 2008 review of the EIS as well)	
NMFS		Section 1.8, lines 27 -28	HCD	The following sentence seems to be misplaced: "This document serves to initiate formal consultation with NMFS under the provisions of the Magnuson-Stevens Act for potential adverse effects to Essential Fish Habitat (EFH)." The section is named "Permits, Licenses, and Entitlements" and the EFH consultation requirement does not fall under this heading. Suggest re-wording the section heading or deleting.	
NMFS		Section 2.1 Objectives	HCD	This section should discuss how the planning objectives have changed over time. According to the information provided, the planning process started in 2001, however the planning objectives have changed substantively in 2004 and 2007. Since the selection and elimination of alternatives is so closely tied to the objectives, more detail should be provided on how objectives have changed over time and the drivers for the change.	
NMFS		2.2.2, Measures Considered for Use in Plan Alternatives	HCD	The EIS states that some of the measures (=project components) independently meet all the objectives, other measures meet the objectives when considered combined with other measures, and some measures, e.g., lightering or the north turning basin, the EIS does not state if the objectives are or are not met. After each measure, the EIS should clearly identify with objectives will be met.	
NMFS		2.5.2.2, Lightering Alternative	HCD	The conclusion that USCG homeland security issues are significant to the point that eliminating the Lightering Alternative is warranted is not supported by an analysis in the EIS. The EIS inaccurately portrays the memorandum as USCG recommending against Lightering, when in fact the memorandum advised there is a risk associated with these activities. Please provide more detail and necessary revisions to this section.	
NMFS		2.5.2.2, Lightering Alternative	HCD	For data quality purposes, the EIS should cite the actual USCG memorandum and not a private consulting firm's website as the citation.	

**COMMENTS REVIEW MATRIX, *cont'd.***

NMFS		2.5.2.2, Lightering Alternative	HCD	The EIS describes elimination of the Lightering Alternative is partially justified because of issues with small vessels (not enough anchor chain, effects of sea state and winds). However, the Lightering Alternative would only be relevant to larger vessels that cannot access the port due to depth and width constraints. The analysis should be revised and updated accordingly.	
NMFS		2.7, Summary of Measures to Avoid and Minimize Impacts to Natural Resources	HCD	More text, a figure, or a table should be provided to further describe how three acres of hardbottom and reef habitats were eliminated.  "Planners reduced the width of the terminus (i.e., the width of the channel at the point where vessels would enter the channel) from 1000 feet to 800 feet. This reduced the impacts to hardbottom and reef habitats by approximately three acres."	
NMFS		2.7 Summary of Measures to Avoid and Minimize Impacts to Natural Resources	HCD	Coral transplantation is planned for an unidentified number of corals greater than 25 cm in diameter or height. In order for NMFS to accept this as a mitigation measure, a detailed plan that includes the number of corals, specific relocation sites, monitoring and performance measures must be provided for our review.	
NMFS		2.7, Summary of Measures to Avoid and Minimize Impacts to Natural Resources	HCD	The size class for the relocation of corals (25 cm) is not substantiated. Other CESAJ authorized projects (Broward Segment III, SAJ-1999-5545) have successfully relocated corals at a much smaller size class. Monitoring reports from this project substantiate the need to relocate scleractinian corals at smaller size classes (6, 7, 8, 9, 10 cm diameter). The corals relocated from this project had a 98% survival success rate at 18-months post-transplantation (NSUOC, 2006).  Nova Southeastern University Oceanographic Center (NSUOC). 2006. Stony Coral Transplantation Monitoring, Fourth Monitoring Report: 18 Month Post-Transplantation Monitoring Event, 40 pages.	
NMFS		2.7, Summary of Measures to Avoid and Minimize Impacts to Natural Resources	HCD	The EIS states that the reduction of the time to complete the project is a mitigation measure. Up to this point in the EIS there has been no discussion on this measure. Specifically, what has changed to reduce the construction time?	
NMFS		2.7, Summary of Measures to Avoid and Minimize Impacts to Natural Resources	HCD	NMFS recommends other mitigation measure be included in the EIS including: assurances that the actual cost of all resource agency approved compensatory mitigation and associated monitoring be included in the budget for the project. This cost should also include contingency mitigation and monitoring.	

**COMMENTS REVIEW MATRIX, *cont'd.***

NMFS		2.7, Summary of Measures to Avoid and Minimize Impacts to Natural Resources	HCD	NMFS recommends other mitigation measure be included in the EIS including: Relocation of octocorals with a strong central spine (of the genera <i>Gorgonia</i> , <i>Eunicea</i> , <i>Plexaura</i> , <i>Plexaurella</i> , <i>Muricea</i> , or <i>Pterogorgia</i> ).	
NMFS		2.7, Summary of Measures to Avoid and Minimize Impacts to Natural Resources	HCD	NMFS recommends other mitigation measure be included in the EIS including: Through this EIS process, we have learned that CESAJ defines “coordinate” differently than NMFS. Commitments are needed to ensure that CESAJ will work with NMFS and other resource trustees so that our <u>substantive input</u> is included in mitigation and monitoring plans that are relevant to our trust resources.	
NMFS		2.7, Summary of Measures to Avoid and Minimize Impacts to Natural Resources	HCD	NMFS recommends other mitigation measure be included in the EIS including: Commitments to work with NMFS and get NMFS approval of the compensatory mitigation plan.	
NMFS		2.7, Summary of Measures to Avoid and Minimize Impacts to Natural Resources	HCD	NMFS recommends other mitigation measure be included in the EIS including: Performance award for completing the project on time and without injury to resources, similar to Key West Harbor Dredging.	
NMFS		2.7, Summary of Measures to Avoid and Minimize Impacts to Natural Resources	HCD	NMFS recommends other mitigation measure be included in the EIS including: Commitments to work with NMFS and get NMFS approval of blasting plan and associated biological monitoring (fish kills).	
NMFS		2.7, Summary of Measures to Avoid and Minimize Impacts to Natural Resources	HCD	NMFS recommends other mitigation measure be included in the EIS including: Commitments to work with NMFS and get NMFS approval of biological monitoring plans.	

**COMMENTS REVIEW MATRIX, *cont'd.***

NMFS		2.7, Summary of Measures to Avoid and Minimize Impacts to Natural Resources	HCD	NMFS recommends other mitigation measure be included in the EIS including: Commitments to work with NMFS and get NMFS approval of plan to monitor (before, after, control, impact) for indirect impacts, i.e., the coral reef habitats deeper than -56 that CESAJ does not believe will be directly impacted.	
NMFS		2.7, Summary of Measures to Avoid and Minimize Impacts to Natural Resources	HCD	NMFS recommends other mitigation measure be included in the EIS including: Commitments to work with NMFS and get NMFS approval of plans to monitor (before, after, control, impact) for indirect impacts, i.e., the seagrass habitats that would be impacted through equilibration of side slopes, sedimentation, turbidity.	
NMFS		2.7, Summary of Measures to Avoid and Minimize Impacts to Natural Resources	HCD	NMFS recommends other mitigation measure be included in the EIS including: Commitments to work with NMFS and get NMFS approval of resource awareness training for all contractors and subcontractors.	
NMFS		2.7, Summary of Measures to Avoid and Minimize Impacts to Natural Resources	HCD	NMFS recommends other mitigation measure be included in the EIS including: Commitments to work with NMFS and get NMFS approval of coral reef sedimentation monitoring plan.	
NMFS		2.7, Summary of Measures to Avoid and Minimize Impacts to Natural Resources	HCD	NMFS recommends other mitigation measure be included in the EIS including: Commitments to work with NMFS and get NMFS approval of coral reef turbidity monitoring plan.	

**COMMENTS REVIEW MATRIX, *cont'd.***

NMFS		2.9.1, overview of Construction of Recommended Plan (2E)	HCD	For data quality purposes, the actual Act should be the citation and not a personal communication citation in "USACE does not specify types of equipment and construction methods within its specifications due to the requirements of the Competition in Contracting Act, that requires Federal agencies to limit how specific specifications are written to prevent limiting competition among contractors (C. Tolle, USACE-SAJ Contracting Officer, pers. comm.).	
NMFS		2.9.3.2, Confined blasting, page 65	HCD	In order for NMFS not to consider this as a dredge material disposal option, CESAJ should further explain under what circumstances (including rock specification) the following would occur:  The harder, consolidated rock obtained from inside the port may be used in the construction of artificial reefs for mitigation.	
NMFS		2.9.3.2, Confined blasting, Page 71	HCD	The EIS should acknowledge that some of the assumptions (i.e., that blasting causes minimal effects to biological resources) may not apply in this case since: The San Juan Harbor project's heaviest delay was 375 lbs per delay and in Miami it was 376 lbs per delay. Based on discussions with USACE's geotechnical engineers, it is expected that the maximum weight of delays for Port Everglades will be larger since the rock is much harder than what is seen at the Port of Miami.	
NMFS		2.9.5, Other Construction Details, page 76	HCD	In our version 1 comments, we requested design specifications and a map of areas where the "environmentally-friendly bulkheads" are planned. CESAJ indicated "partial concurrence" with this comment. Please provide a map of these areas.	
NMFS		2.9.5, Other Construction Details, page 76	HCD	The drawing provided (figure 36) is not sufficient to show that (as stated in the EIS), "the rip-rap would allow sufficient water to pass through the rocks to continue flushing of mangroves located behind them and allow juvenile fishes access to the mangroves. Notches in the rip rap, similar to those at the JUL mangrove areas, may also be able to be installed to allow greater flushing and subsequent access by juvenile files." We note that the notches are also not shown on the drawing and these will be critical to determine if fish ingress and egress is possible.	
NMFS		2.9.5, Other Construction Detailspage 76, line 37	HCD	It is not accurate to state "NMFS... developed an "environmentally-friendly bulkhead (EFB)..." We request the following change (in italics): FWS and NMFS developed <i>the concept of an EFB</i> .	
NMFS		3.2, Land Use, page 81, line 45	HCD	For data quality purposes, the most recent census data should be included in the EIS	
NMFS		3.5.1, Upland habitat, Page 85	HCD	Fig 39 is not included in the EIS	
NMFS		3.5.2, Wetlands, Page 86, line 30	HCD	The report NMFS HCD prepared should be referred to as "Characterization of Essential Fish Habitat in the Port Everglades Expansion Area" or (NMFS 2011). It should not be referred to as an "EFH analysis" (Appendix H)	

**COMMENTS REVIEW MATRIX, *cont'd.***

NMFS		3.5.2, Wetlands, Page 86, line 30	HCD	In the comment above, appendix G (not H) should be referenced.	
NMFS		Page 86, Line 44 Page 88, lines 24-25 page 89, line 38 page 90, line 8 page 91, lines 8, 27, and 47  And anywhere else in the document	HCD	Please change “NMFS EFH Assessment (Appendix H)”, to “Characterization of Essential Fish Habitat in the Port Everglades Expansion Area” or (NMFS 2011). Also please list the accurate appendix, where referenced.	
NMFS		3.5.2, Wetlands Figure, 40, page 87	HCD	Please change the caption to: Mangrove Assessment Areas Hatching indicates mangrove habitat and numbered arrows point to assessment areas identified by colored polygon. Figure from NMFS 2011 (and modified from DCA 2001).	
NMFS		3.5.2, Wetlands Page 87, line 25	HCD	This parentheses should include reference to figure 40 and figure 41	
NMFS		3.5.2, Wetlands Figure 41, page 88	HCD	Please add the following to the figure caption: (figure from NMFS 2011)	
NMFS		3.5.2, Wetlands	HCD	The mangrove <i>types</i> referred to in this section is not clear. Is a <i>type</i> a habitat characterization, a particular area, or both?	
NMFS		Several places in the document	HCD	Some revisions were made to the final report (NMFS 2001). Please make sure any sections that have been cut and pasted are from the final version sent to CESAJ on June 3, 2011.	
NMFS		3.6, Marine Resources, Page 92, lines 17-18	HCD	For data quality purposes, the date should be included in all personal communication references	

**COMMENTS REVIEW MATRIX, *cont'd.***

NMFS		3.6.1.1, Marine Resource Investigations, lines 11-14	HCD	<p>From the EIS: “The 1999 environmental baseline surveys for seagrasses occurred within the project area, which started approximately 1,200 feet north of the Port Inlet south, along the AIWW, to approximately 1,000 feet south of the DCC and along the DCC to Port Denison (DC&amp;A 2000) (Figure 43).”</p> <p>“Port Denison” is not a feature that NMFS is familiar with (nor is it identified in figure 43). Please describe where this is located. NMFS can also add to figure 43, if CESAJ would like.</p>	
NMFS		3.6.1.1, Marine Resource Investigations	HCD	DCA 2000 is missing from the literature cited	
NMFS		3.6.1.1, Marine Resource Investigations	HCD	<p>The EIS states “In 2006 seagrass surveys were conducted in the same project area as 1999 surveys (not including areas further south than ~1,000 feet south of the DCC) (DC&amp;A 2006).”</p> <p>This sentence should be revised to state:  <i>In 2006 seagrass transects were placed in areas where seagrass had been previously documented in the 1999 surveys. Transects that did not contain seagrass in 1999 were not resurveyed in 2006.</i> In addition, the 2006 survey did not include areas if the AIWW located more than ~1,000 feet south of the DCC) (DC&amp;A 2006).</p> <p>This distinction is important because it is unknown if any areas that were unvegetated in 1991 recruited seagrass in 2006. This is depicted in figure 2 in DCA 2006.</p>	
NMFS		3.6.1.1, Marine Resource Investigations	HCD	<p>In 2009, seagrass surveys were conducted in the same project area as 2006 surveys (not including areas further south than ~1,000 feet south of the DCC) (DC&amp;A 2009; see Appendix D).</p> <p>This sentence should be revised to state:  <i>In 2009 seagrass transects were placed in areas where seagrass had been documented in the 2006 surveys</i> (not including areas further south than ~1,000 feet south of the DCC) (DC&amp;A 2006).</p>	
NMFS		3.6.1.1, Marine Resource Investigations	HCD	If in 2006 and 2009, reconnaissance surveys were performed for the entire project area, the project area, survey approach, and survey conditions (visibility, etc.) should be described.	
NMFS		3.6.1.1, Table 8	HCD	Please add to the caption: (table from NMFS 2011, Appendix G)	

**COMMENTS REVIEW MATRIX, *cont'd.***

NMFS		3.6.1.2, <i>Seagrass Species Biology and Ecology</i> figure 43	HCD	Please add to the caption: (figure from NMFS 2011, Appendix G)	
NMFS		3.6.1.3, <i>Local Seagrass Biogeography</i> page 96 lines 34-35	HCD	Please change “NMFS EFH Assessment (Appendix H)”, to “Characterization of Essential Fish Habitat in the Port Everglades Expansion Area” or (NMFS 2011). Also please list the accurate appendix, where referenced.	
NMFS		3.6.1.4, <i>Water Quality and Local Seagrasses</i> page 96, line 16	HCD	This line refers to NMFS 2011 as Appendix A, please list the accurate appendix, where referenced.	
NMFS		3.6.2, Hardbottom Communities	HCD	<p>This section should be renamed to “Coral Reef” or “Hardbottom and Coral Reef”. Several publications (see Reef Terminology section of our letter and Rohmann et. al 2005, in the journal “Coral Reefs”) term the feature that is described in this section as “Coral Reef.” Not naming it as such appears to be an attempt to avoid calling the feature a reef.</p> <p>Rohmann, S., Hayes, J., Newhall, R., Monaco, M., Grigg, R. 2005. The area of potential shallow-water tropical and subtropical coral ecosystems in the United States. <i>Coral Reefs</i>. 14 pages</p>	
NMFS		3.6.2, Hardbottom Communities	HCD	The first paragraph in this section largely refers to what the coral reef system is not; NMFS recommends this section be revised to characterize the corals reefs in the project area. If CESAJ wants to point out differences between high latitude coral reefs and corals reefs to the south that should be accomplished in another section (not the introductory paragraph in the section that describes coral reefs).	

**COMMENTS REVIEW MATRIX, *cont'd.***

NMFS		3.6.2, 3.6.2, Hardbottom Communities page 99, lines 8-9	HCD	<p>The characterization of nearshore hardbottom communities off southeast Florida does not include the best scientific information. In particular the statement "These hardbottom areas are comprised of exposed rock with a fine covering of sand" is out-dated and does not reflect the best available information on this habitat type (e.g., CSA 2009 – CESAJ served on the technical advisory team for the preparation of this report).</p> <p>Continental Shelf and Associates. 2009. Ecological Synthesis of Nearshore Hardbottom Habitats in Southeast Florida, 267 pages.</p>	
NMFS		3.6.2, 3.6.2, Hardbottom Communities page 99, lines 7-13  Page 103-104	HCD	<p>Nearshore hardbottom habitats are generally describes as the hardbottom features in 0 to 4 meters water depth (CSA 2009). The portion of theEIS refers to shallow colonized pavement in the nearshore hardbottom as well, which is not accurate.</p> <p>"This habitat is very ephemeral in nature and the species associated with this habitat must be able to quickly recover from the stresses imposed by the environmental conditions." This is an overgeneralization and should be updated with the best available information as found in CSA 2009 (full reference provided in the preceding row).</p>	
NMFS		3.6.2, 3.6.2, Hardbottom Communities page 99, line 43	HCD	<p>For data quality purposes, the following statement should be followed by a citation or deleted: "These communities can be expected to recolonize these areas after future dredging events, as they have done so in the past"</p>	
NMFS		3.6.2, 3.6.2, Hardbottom Communities page 101-103	HCD	<p>Since this section is under revision, we do not see the value in providing line-by-line comments. However if the goal of this section is to provide a characterization of the coral reef habitats in the project area, we recommend CESAJ adopt a similar approach as in the seagrass section which includes use of relevant sections of NMFS 2011.</p> <p>Regardless, this is an important component of the EIS and we recommend CESAJ coordinate this section with cooperating agencies for review prior to the public version of the EIS.</p>	

**COMMENTS REVIEW MATRIX, *cont'd.***

NMFS		3.6.2, 3.6.2, Hardbottom Communities page 103 Lines 48-49	HCD	For data quality purposes, we recommend CESAJ incorporate more recent literature in the EIS. This section states: "These hardbottom communities have been characterized many times in the past (Dodge 1991; Seaman 1985)." Update literature can be found in NMFS 2011. All the references cited in NMFS 2011 were provided to CESAJ in June 2011.	
NMFS		3.6.4, Essential Fish Habitat	HCD	The EFH section is incomplete and "under review". Since this section is under revision, we do not see the value in providing line-by-line comments. However if the goal of this section is to provide a characterization of the coral reef habitats in the project area, we recommend CESAJ adopt a similar approach as in the seagrass section which includes use of relevant sections of NMFS 2011.  Additionally, this is an important component of the EIS and we recommend CESAJ coordinate this section with NMFS for review prior to the public version of the EIS.	
NMFS		3.7.2.1, <i>Johnson's Seagrass</i> , page 109 line 25-26	HCD	The northernmost range of Johnson's seagrass has been extended to 21.5 km north of Sebastian Inlet (Virmstein and Hall 2009).  Virmstein, R.W., and Hall, L.M. 2009. Northern range extension of the seagrasses <i>Halophila johnsonii</i> and <i>Halophila decipiens</i> along the east coast of Florida, USA. <i>Aquatic Botany</i> 90: 89-92.	
NMFS		3.10, Hazardous, Toxic, and Radioactive Waste, lines 4-5	HCD	This section states: "Sediments sampled within the OEC, IEC, NTB, MTB, and STB have been tested and found suitable for ocean disposal." For data quality purposes, please provide citations from the studies and include the full reference in the literature cited section.	
NMFS		3.17, Economics and Logistics, Section Economics and logistics	HCD	This section should be expanded in scope to include economic benefits that natural resources that would be negatively affected provide. Information from: Johns, G. M., Leeworthy, V. R., Bell, F.W. & Bonn, M. A. (2001) <i>Socioeconomic Study of Reefs in Southeast Florida</i> . Final Report. Hazen and Sawyer Environmental Engineers & Scientists  Fonseca, M.S., W.J. Kenworthy, G.W. Thayer. 1998. Guidelines for the Conservation and Restoration of Seagrasses in the United States and Adjacent Waters. U.S. Department of Commerce, National Oceanic and Atmospheric Administration. Coastal Ocean Office, 1315 East-West Highway, Silver Spring, Maryland 20910. 222 pp. Web: <a href="http://www.cop.noaa.gov">http://www.cop.noaa.gov</a> .  Fonseca, M., Kenworthy, J., Julius, B., Shutler, S., and Fluke, S. 2000. Handbook of Ecological Restoration. Davy and Perrow, eds. Cambridge University Press. Chapter 7: Seagrasses, 23 pages	

**COMMENTS REVIEW MATRIX, *cont'd.***

NMFS		3.19 Navigation Safety	HCD	This section is under development. An evaluation of NOAA PORTS to increase navigation safety at the port should be included in this section.	
NMFS		4.1, Environmental Consequences	HCD	This section states "See section detailing effects to Essential Fish Habitat where "water column" is noted in order to review effects on surface waters."  It is unclear where this information is provided	
NMFS		4.3, Wetlands	HCD	It is unclear how CESAJ determined 1.16 acres of mangrove would be dredged (direct impact). Also, the EIS does not quantify the indirect impacts to mangroves that would result from equilibration of the side slopes or sedimentation and turbidity. Please update this section accordingly.	
NMFS		4.3, Wetlands Page 142	HCD	Figure 51 depicts that the mangroves in the turning notch will be dredged. This contradicts information in the EIS stating that this component of the project has been eliminated.	
NMFS		4.7, Cumulative Impacts	HCD	This section presents a narrow review of cumulative impacts. Please add a summary table of habitat impacts by project and habitat type. Please include the habitat impacts for all of the activities that are referred to by reference as well.	
NMFS		4.7, Cumulative Impacts	HCD	CESAJ's conclusion on cumulative impacts, is not supported by any analysis. Please provide the analysis used to determine "USACE anticipates that any cumulative impacts due to past and future projects at the Port and within its vicinity are negligible and not significant."	

Review of Severe Impacts to Coral Reef and Hardbottom in the Federal Channel  
that Would Result from Expansion of Port Everglades  
July 31, 2013

Prepared by:  
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Summary: NOAA's National Marine Fisheries Service (NMFS) and Nova Southeastern University characterized the coral reef impacts that would result from the Port Everglades Expansion Project and conclude 21.66 acres of coral reef located in the federal channel will be severely impacted by the planned expansion. This estimate of direct impacts is approximately 6.49 acres larger than the estimate in the draft Environmental Impact Statement (EIS) prepared by the U.S. Army Corps of Engineers (USACE). Coral reef communities in the channel would be directly impacted through: (1) removal by the dredge, (2) coral fragments and dredged material including rubble and sediments moving downslope or down current abrading and shearing coral reef organisms from the substrate, and (3) fractures in the reef framework, lithified coral and underlying rock destabilizing attachment of coral reef organisms. The latter two impacts create an unstable coral reef environment resulting in lower coral abundance and fewer large coral colonies. The steeply sloped, eastward facing spur-and-groove reef habitats are particularly at risk from the downslope movement of sediment and rubble. The draft EIS describes a tentatively selected plan that includes expanding the Outer Entrance Channel from the existing width of 500 feet to 800 feet and deepening the channel from approximately -42 feet Mean Low Water (MLW) to -57 feet MLW. USACE's estimate of direct impacts to coral reef habitats, approximately 15.17 acres, is limited to removal by the dredge and the draft EIS further concludes there will be no impacts to coral reef communities outside the dredged footprint. Figure 1 depicts the areas at-risk of fracture impacts, and it may be possible to minimize a portion of the 8.16 acres of severe impacts at Port Everglades by stabilizing the seafloor immediately following the dredging, however, such reef stabilization is not proposed in the draft EIS.

Introduction: Channel creation or widening may result in a total loss of coral reef organisms and structure (Walker et al. 2012; PBSJ 2008). Dredging impacts may include reef fracturing from static and dynamic loading during dredging activities (Maharaj 2001; PBSJ 2008); fractured material eroding during storms (NOAA 2002; Edwards and Gomez 2007); rubble or sediment moving downslope and shearing or burying coral reef habitats (Edwards and Gomez 2007; Collier et al. 2008); and chronic sedimentation. Unstabilized rubble can delay recovery of an injury area for decades or prevent recovery of impacts to corals altogether (Edwards and Gomez 2007). Gilliam and Moulding (2012) found the increased rubble at coral injury sites significantly lowered the number of stony coral species, the percent cover and density of stony corals, and the size of the largest coral colony present. The same study found increased coral rubble significantly lowered the biomass of sponges and the number of genera and percent cover for octocorals. While rubble may be suitable for coral recruitment, it is not suitable substrate for continued coral colony growth or reef development (Edwards and Gomez 2007; Gilliam and

Moulding 2012). Lastly, coral reef injury sites have lower rugosity, which is an important habitat parameter for finfish (Walker et al. 2009, Pittman and Brown 2011), with fish abundance and species richness higher on more rugose reefs.

Three approaches have been used to quantify and characterize the direct impacts that would occur to coral reef habitat from expanding the Port Everglades federal navigation channel. Each approach is briefly described below and results provided in Table 1:

- Walker et al. (2008) quantifies impacts to the Outer Reef and the Middle Reef using available habitat maps and the proposed channel expansion area. This analysis assumes that all coral reef and hardbottom habitats within the channel expansion footprint, regardless of depth, would be directly impacted.
- The draft EIS concludes only the coral reef habitats located within the federal channel expansion area and shallower than -57 feet MLW would be directly impacted.
- This report concludes the coral reef habitats located within federal channel and in water depths shallower than -57 feet MLW would be directly impacted by the dredge removing the corals and underlying substrate. In addition to these impacts, the coral reef habitats deeper than -57 feet MLW would also be adversely affected by coral fragments and dredged sediments moving downslope or down current shearing coral reef organisms and by fractures in the rock and lithified coral propagating into the reef framework destabilizing the attachment of coral reef organisms.

Methods: Coral reef habitats seaward of the Inner Reef were examined in a GIS. GIS layers used in this assessment include:

- impact maps provided by the USACE
- bathymetry provided by Dr. Brian Walker (Nova Southeastern University)
- benthic habitat maps provided by Nova Southeastern University
- LIDAR digital elevation model surface provided by Nova Southeastern University
- hill-shaded LIDAR images provided by Nova Southeastern University

Coral reef habitats were delineated by Dr. Brian Walker using these GIS layers. Habitat classifications are based on Walker et al. (2008), which is based on the NOAA hierarchical classification scheme used in other NOAA mapping efforts in the Atlantic/Caribbean and described in Kendall et al. (2001) and Kendall et al. (2006).

Results: Two linear reefs are located within the assessment area: the Linear Reef-Middle and Linear Reef-Outer (Figures 1 and 2). Linear-Reef Middle is composed of one habitat type, referred to as linear reef. The Linear Reef-Outer is composed of colonized pavement, linear reef, and spur-and-groove habitats (Figure 2). In addition, 0.498 acres of previously undocumented coral reef or hardbottom habitat occurs west of this reef and appears to be a western extension of the colonized pavement (Figure 2). Each of these three areas is discussed below in greater detail.

*Linear Reef-Middle located in water depth greater than -57 feet MLW:* This habitat consists of the eastern side of the Linear Reef-Middle habitat from the proposed dredged depth of -57 feet to approximately -67 feet MLW at the eastern edge and includes 2.144 acres of steeply sloped reef face habitat (ranging from near vertical to approximately 3:1 slope) downslope from the proposed dredged channel (Table 4). NMFS characterizes the physical impact that would occur

as fractured reef framework, substrate scarring, erosion of fractured reef framework, increased rubble, displacement and shearing of biota, rubble burial or partial burial of coral reef, rubble and sediment movement downslope, rubble abrasion of coral reef, sedimentation (Table 2). NMFS also expects that fish assemblages would be negatively affected by turbidity and exhibit lower species richness and lower abundance. In addition, NMFS expects reduced number of stony corals, reduced stony coral percent cover, reduced largest coral colony size, reduced sponge biomass, reduced octocoral percent cover, reduced octocoral genera, and adverse effects to corals from increased sedimentation and turbidity. Furthermore, the landscape scale negative impacts that would occur include habitat fragmentation, reduced edge habitat, and reduced topographic complexity.

*Linear Reef-Outer, Colonized Pavement greater than -57 feet MLW:* This habitat is located on the western side of the Linear Reef-Outer habitat, from -57 feet MLW to approximately -64 feet MLW and includes 1.582 acres of moderately sloped (greater than 3:1) reef habitat (Table 4). The proposed elevation of -57 feet MLW will be similar to the depth of the adjacent unconsolidated sediments, which will result in chronic sedimentation impacts to reef habitats due to natural sand transport. NMFS expects the impacts to be the same for Linear-Reef Middle (Table 2).

*Linear Reef-Outer, Spur and Groove greater than -57 feet MLW:* The eastern face of the Linear Reef-Outer spur-and-groove habitat includes 3.914 acres of steeply sloped (the reef generally ranges from near vertical to approximately 3:1, high-complexity, coral reef habitat downslope of the limits of dredging (Table 4). This habitat slopes steeply from the existing elevation of -45 feet MLW to approximately -76 feet MLW. NMFS expects the impacts in this area to be the same as in other linear reef areas (Table 2).

*Previously unmapped hardbottom/boulders in depths greater than -57 feet MLW:* Previous mapping was based on a one-acre minimum mapping unit, thus patches of coral reef habitat smaller than one acre were not delineated. The current effort used a smaller minimum mapping unit and found 0.087 acres of hardbottom/boulders adjacent (east) of the Linear Reef-Middle (Table 3), and a 0.498-acre western extension of Linear Reef-Outer (Table 4) within areas previously mapped as sand. Although in situ confirmation of these areas is lacking, topographic signatures in LIDAR-based bathymetry indicate that these areas are likely hardbottom or boulders that include coral reef communities.

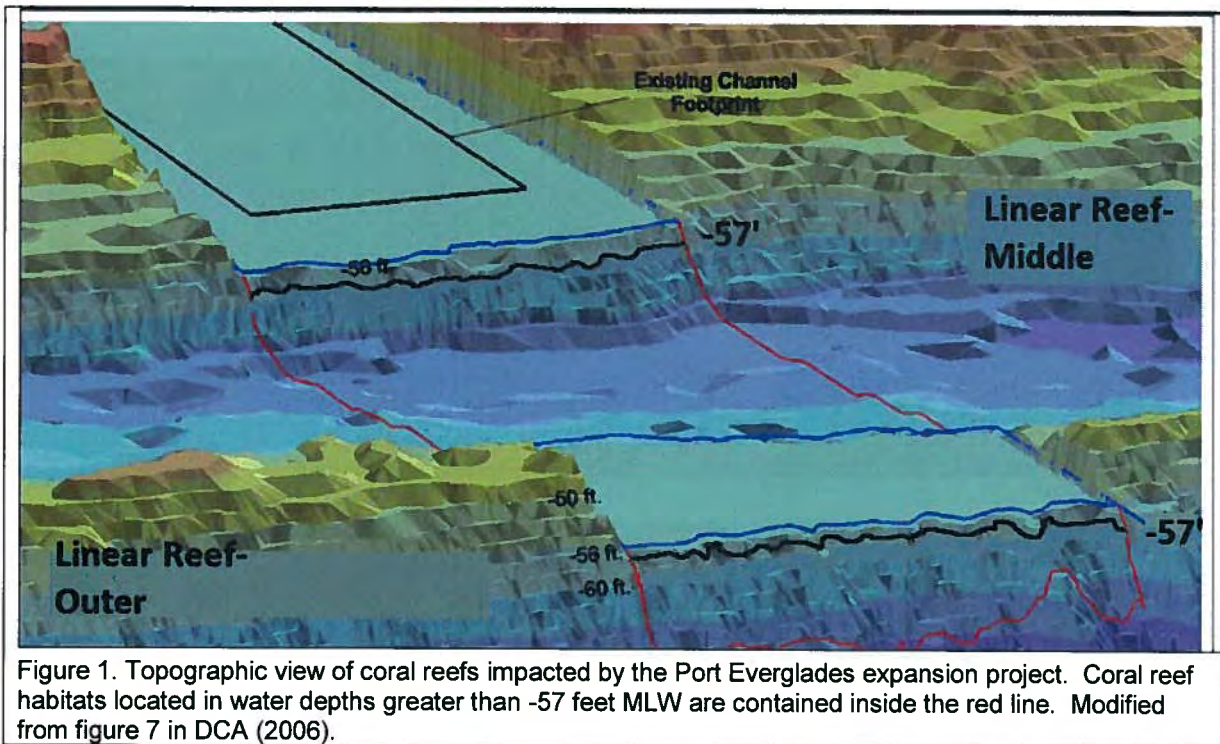
Discussion: NMFS expects severe impacts to 21.66 acres of coral reef habitat from expansion of the Port Everglades Outer Entrance Channel, 8.16 acres of the impacts will be to coral reef habitats deeper than -57 feet MLW, which are not included in the draft EIS (Tables 3 and 4). The steeply sloped, eastward-facing reef spur-and-groove habitats are particularly at risk due to the downslope movement of sediment and rubble. While these 8.16 acres of impact are outside the dredging footprint, the impacts are nonetheless severe. The physical and biological impacts to this habitat type include but are not limited to fractured reef framework, increased rubble, reduced topographic complexity, fish assemblage lower species richness and abundance, reduced number of stony coral species, and reduced stony coral and octocoral percent cover (Table 2). The final EIS should include these areas as direct impacts. Tables 3 and 4 also include the addition of 0.59 acres of previously unmapped hardbottom or boulder habitats and correction of

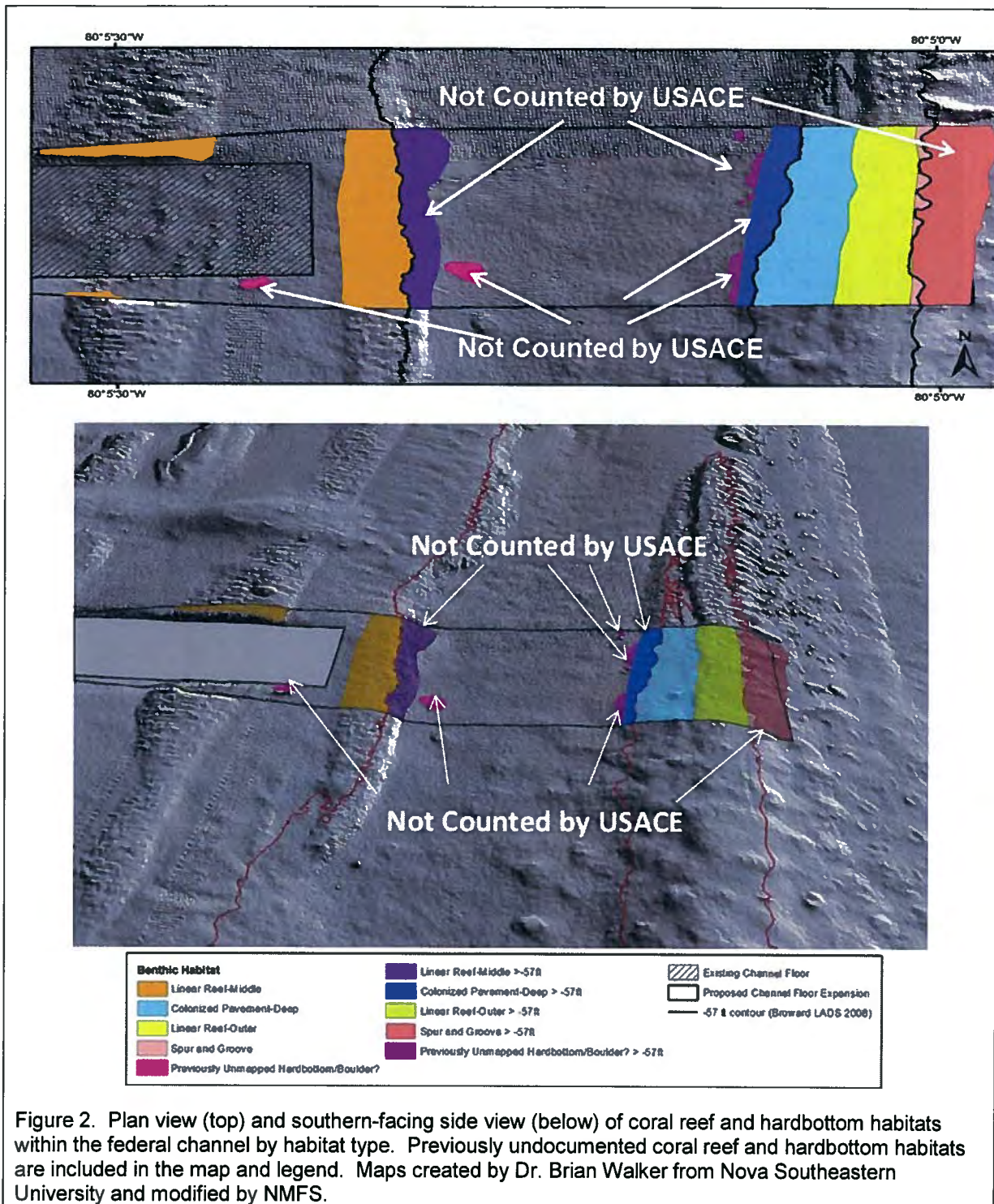
inaccurate estimates of impact areas to mapped habitats. In addition to these habitat impacts, NMFS expects fish assemblages to become significantly smaller and species richness to decline due to the loss of topographic complexity resulting from the project. Further, the increased width of the proposed channel will extend the area of reduced habitat complexity and reduced cover for reef fish, resulting in greater habitat fragmentation (Caddy 2008). The reduced cover provided to fish as a result of dredging the habitat could result in increased predation on managed species and other motile organisms that cross the expanded channel.

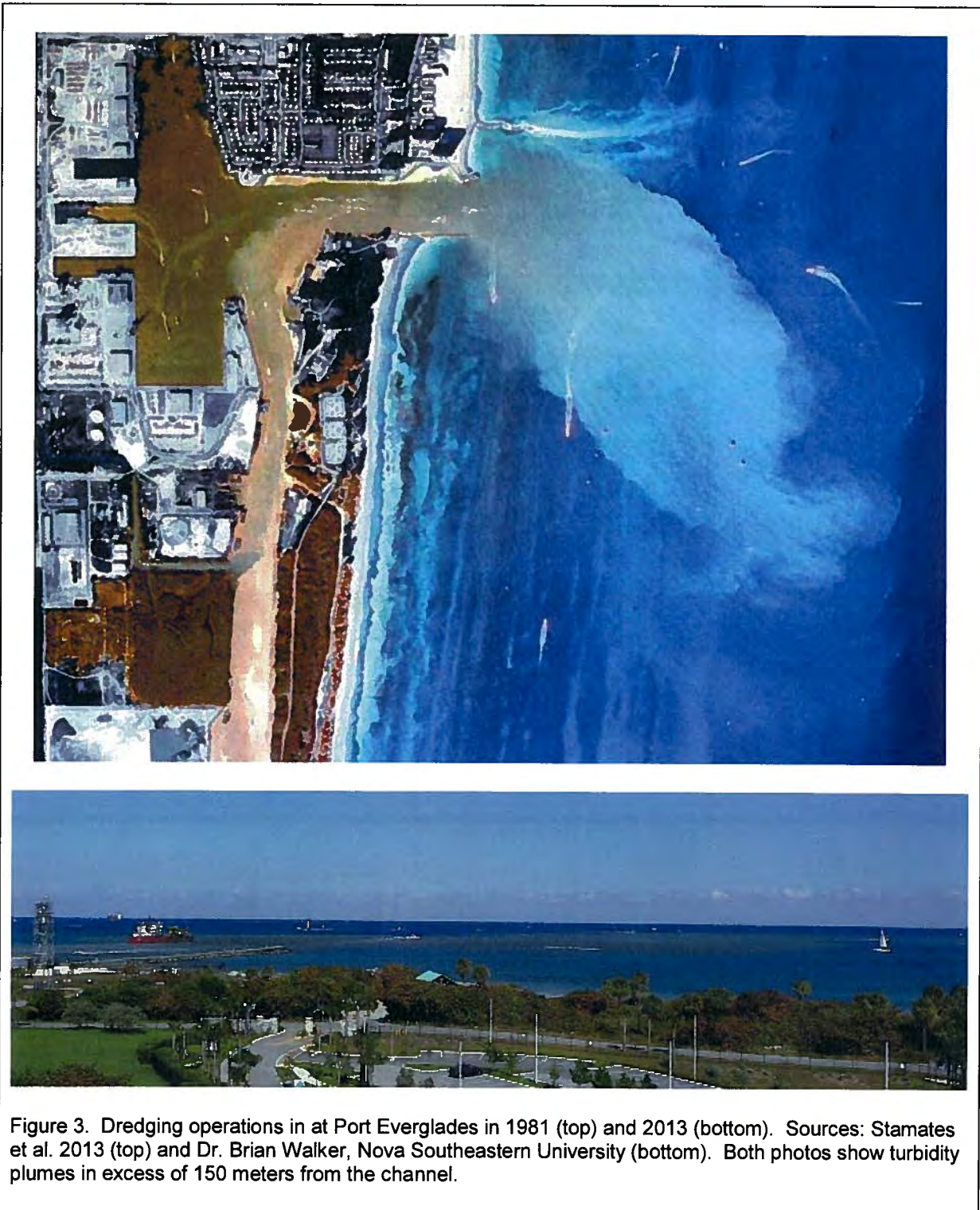
Chronic impacts to coral reefs from sedimentation and turbidity after dredging can have a greater impact than acute stress (Rogers 1979). Indirect impacts from the Port Everglades Expansion project are estimated to be 117.49 acres, based on an unverified assumption that sedimentation and turbidity impacts will be limited to a 150 meter mixing zone around the channel. Research has shown the vicinity of Port Everglades has a very complex and dynamic hydrologic regime (Stamates et al. 2013). Dredging activities in the vicinity of Port Everglades resulted in a turbidity plume greatly exceeding the 150 meter mixing zone that has been used as the basis for calculating indirect impacts in the USACE assessment (Figure 3). Indirect impacts to coral reefs differ from direct impacts in temporal and spatial scales but may be as severe as direct impacts. Relying on an unverified assumption that sedimentation and turbidity impacts only occur within the 150 meter mixing zone is expected to under estimate the extent and magnitude of indirect impacts from the project.

Recommendations:

1. USACE should update the EIS and EFH Assessment for the Port Everglades Expansion Project to reflect 21.66 acres of direct impacts to coral reef located in the federal channel.
2. Indirect impacts should be examined using GIS information and hydrographic modeling, with a supporting literature review, to determine the extent and magnitude of indirect impacts.
3. The compensatory mitigation plan should describe how direct impacts of 21.66 acres and an as yet undetermined amount of indirect impacts to coral reef habitats would be fully offset.
4. USACE should modify the dredging plan to include, as an impact minimization measure, substrate stabilization to reduce the amount of coral reef habitat adversely affected by coral fragments and dredged rubble and sediments moving downslope or down current, abrading and shearing coral reef organisms and by fractures in the reef framework, lithified coral and underlying rock destabilizing the attachment of coral reef organisms.







**Table 1: Results from three approaches to describe the direct impacts that would occur to coral reef habitat within the federal channel from Port Everglades expansion.**

Study Characterization	Direct Impacts	Direct impacts deeper than -57 feet MLW
Walker et al. (2008)	20.34 acres	Included in direct impact calculations
USACE (2013)	15.34 acres	Included within indirect impacts injury category within and 150 meters outside federal channel
Present Study	15.56 acres	6.11 acres

**Table 2: Expected impacts to coral reef and hardbottom habitat types in water depths greater than -57 feet MLW and previously unmapped habitats in the Port Everglades federal channel.**

Category of impact expected	Linear Reef Middle >57 ft MLW	Linear Reef Outer, Colonized Pavement >57 ft MLW	Linear Reef Outer, Spur and Groove >57 ft MLW	Previously unmapped hardbottom >57 ft MLW	Previously unmapped hardbottom <57 ft MLW
<b>Physical Impacts</b>					
fractured reef framework	x	x	x		
substrate scarring	x	x	x	x	x
erosion of fractured reef framework	x	x	x		
increased rubble	x	x	x	x	x
displacement and shearing of biota	x	x	x	x	x
rubble burial or partial burial of coral reef	x	x	x	x	x
rubble and sediment movement down slope	x	x	x	x	x
rubble abrasion of coral reef	x	x	x	x	x
sedimentation	x	x	x	x	x
<b>Biological Impacts - Fish</b>					
fish assemblage lower species richness	x	x	x	x	x
fish assemblage lower abundance	x	x	x	x	x
turbidity	x	x	x	x	x
<b>Biological Impacts - Benthic</b>					
reduced number of stony corals	x	x	x	x	x
reduced stony coral percent cover	x	x	x	x	x
reduced stony coral density	x	x	x	x	x
reduced largest colony size	x	x	x	x	x
reduced sponge biomass	x	x	x	x	x
reduced octocoral percent cover	x	x	x	x	x
reduced octocoral Genera	x	x	x	x	x
sedimentation	x	x	x	x	x
turbidity	x	x	x	x	x
<b>Ecological Impacts - Landscape</b>					
habitat fragmentation	x	x	x		
reduced "edge" habitat	x	x	x		x
reduced topographic complexity	x	x	x	x	x

**Table 3: Coral reef impacts within the federal channel by habitat type in water depths less or equal to -57 MLW. Table modified from Walker et al. (2008) and Karazsia and Wilber (2011). Updates to impact estimates from previous analyses resulted from incorporation of higher resolution bathymetry and improved GIS analyses.**

Habitats within the Federal channel	Type	Modifiers	Area (ft <sup>2</sup> )	Acres (ac)	Type ac
Coral reef and Colonized hardbottom	Outer Reef	Spur and Groove	16,800	0.386	8.764 <sup>1</sup>
		Linear Reef-Outer	179,395	4.118	
		Colonized Pavement-Deep	185,560	4.260	
	Middle Reef	Linear Reef-Middle	202,388	4.646	4.733 <sup>2</sup>
		Previously Unmapped Hardbottom/Boulders	4,102	0.087	
Inlet Channel Floor	Inlet Channel Floor	Inlet Channel Floor	2,341,644	28.59	53.76
Soft Bottom	Sand	Sand	1,228,497	28.20	28.20

<sup>1</sup> USACE (2013) estimates 10.10 ac; Walker et al. (2008) estimates 13.54 ac

<sup>2</sup> USACE (2013) estimates 5.07 ac; Walker et al. (2008) estimates 6.80 ac

**Table 4: Coral reef impacts within the federal channel by habitat type in water depths greater than -57 MLW.**

Habitats within the federal channel deeper than -57 MLW	Type	Modifiers	Area (ft <sup>2</sup> )	Acres (ac)	Type (ac)
Coral reef and Colonized hardbottom	Outer Reef	Spur and Groove	170,481	3.914	6.016
		Colonized Pavement	68,927	1.582	
		Linear Reef - Outer	947	0.022	
		Previously Unmapped Hardbottom/Boulders	21,598	0.498	
	Middle Reef	Linear Reef-Middle	93,398	2.144	2.144

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### Hardbottom and Reef Community Mapping

The EIS does a poor job outlining exactly what was done to determine the areas of impacts to the reef communities. It mentions that Dial Cordy mapped the area using video cameras and benthic assessments, however no mapping protocols were provided to determine how the mapping was performed. Almost all of the figures showing the reefs (Figs. 6, 51, 73, and 74) depict polygons created by Nova Southeastern University for FWC and FL DEP without citation. Only Figure 59 in the EIS cites the habitat maps. No discussion is provided on how these polygons were drawn or the criteria and purpose behind them.

All mapping efforts are contingent upon their own objectives and scope. The results directly depend on the methodology, scale, and classification scheme developed to meet the mapping objectives. The maps used by the USACE created by NSU were developed for a county-wide mapping of benthic habitats. Due to the scale of mapping reefs county-wide and budgetary constraints, there were compromises made in the map scale. Ideally maps would be created at the finest scale possible. Limits were placed on the Broward mapping effort to draw polygons at a 1:3000 scale with a minimum mapping unit of 1 acre. This has implications on the results. The limitation on the polygon scale means that edges won't be precise at scales finer than 1:3000. This affects the amount of area calculated from the polygons. Because it was not economically feasible (outside of the budget) to trace every intricate small feature at the finest scale, limitations of the minimum mapping unit (polygon size) were set to 1 acre. The limit on minimum mapping unit means that features less than 1 acre were not included in the map. This also affects the amount of habitat area calculated by the polygons. Finally the classification was designed around what habitats could be depicted at the scale and minimum mapping unit using the remote sensing datasets at hand. The primary remote sensing dataset was lidar from 2001 collected by Broward County. This was supplemented by aerial photography where possible, mostly in the nearshore. Therefore broader classifications were used to depict the environment than what might be used with different technology or on a project of smaller scale.

In the mid-2000s, members of the Port Everglades Research Group (FWC and NSU) recommended the offshore reefs within the Port Everglades project footprint should be mapped at a finer scale. Apparently the USACE did not take this advice into consideration as it was not reported in Appendix E3, the Reef Group Recommendations Report. Although the NSU county-wide maps met their objectives well and were measured to be accurate at a large scale, a finer-scale map would have produced better results to determine impacts around Port Everglades. For example, Broward County is planning a sand bypass project on the north side of Port Everglades. Although the NSU maps were available, the county decided to perform a finer scale mapping for the project area. This resulted in a much finer-scale mapping effort with a scale and classification fitted to the project objectives. Figure 1 shows a comparison of these results. The sand bypass polygons are the black outlines on top of the county-wide colored map. The edges of features changed significantly as well as habitat classifications and polygon sizes. These differences were due to a change in the scope of the mapping effort and the finer-scale mapping criteria used. A similar result would be expected from a finer-scale mapping around Port Everglades.

Attachment 3

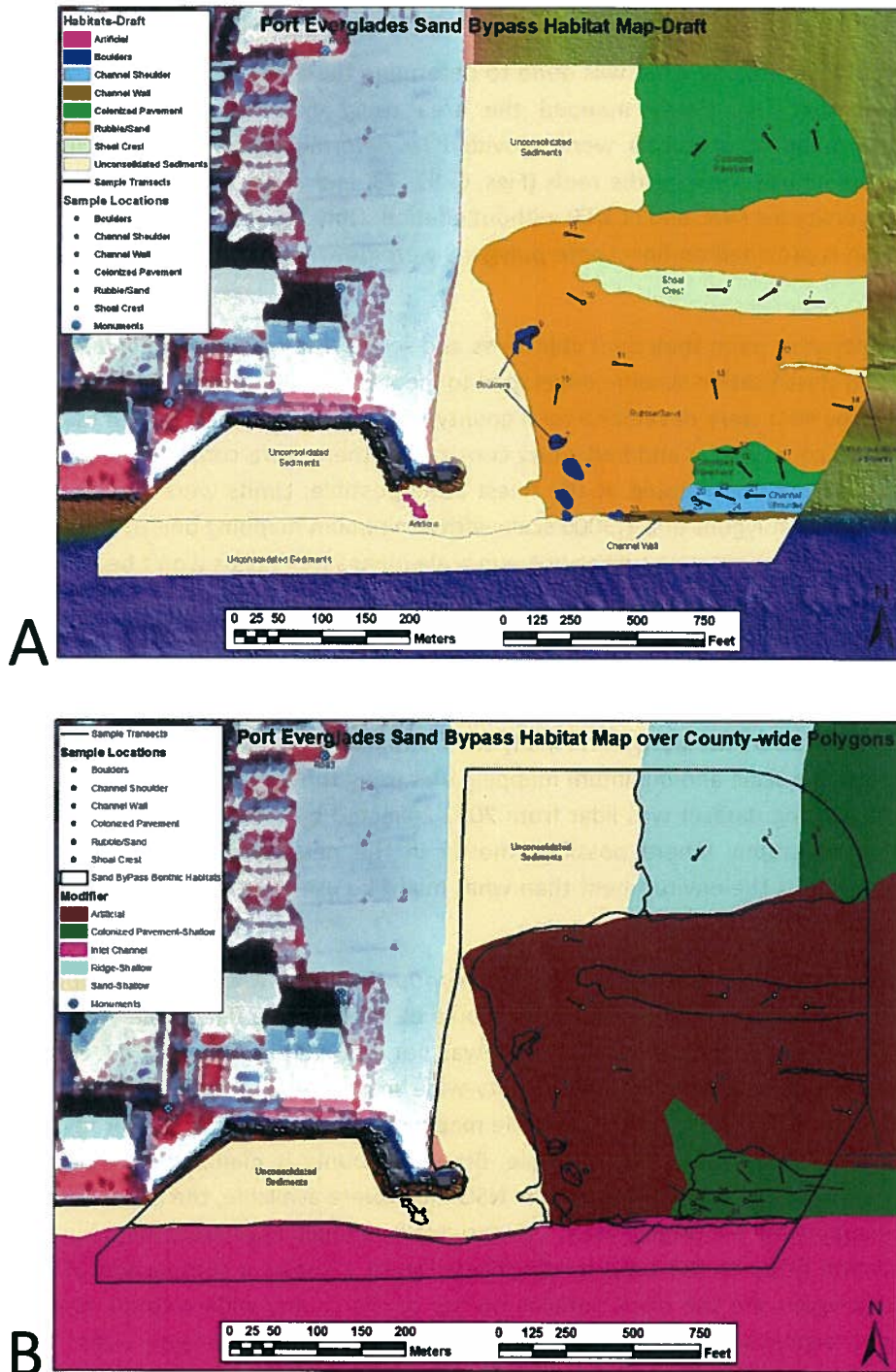


Figure 1. A. Final fine-scale sand bypass map. B. Sand bypass map overlain on the larger-scale county-wide NSU map. The finer-scale map shows more defined habitat edges, smaller features, and a classification scheme designed for the specific area of interest. It is likely that a finer-scale map of Port Everglades project would likely benefit in a similar way.

## Attachment 3

### Benthic Habitat Impacts

As stated above, the county-wide habitats are not a precise representation of the Port Everglades project footprint and may not depict the habitats at the most appropriate scale. However, we use them here for comparison to the USACE methodology and results to determine impact areas for mitigation.

The EIS does not do a good job explaining how benthic habitat impact areas were determined. The best we can tell, the county-wide polygons were clipped to depth contours in the lidar data and the area shallower was summed for direct impacts. Proposed alternative 2E (TSP) has several areas listed for impacts based on the selected depth. Although this was done for 5 depths we focused here on the -59 as it also pertains to the Port Everglades EIS Appendix 2E – Mitigation. Much of the following discussion may likely apply to the impacts at other depths as well.

Appendix 2E did not explain the methodology behind calculating the impacts areas for mitigation well. One confusing aspect was on page 12 it states "Scenario 2, i.e., in the event of no cable and anchor impacts, would result in 16.64 acres of impact to the middle and outer reef combined, of the project is dredged to the recommended alternative – 57 feet total dredge depth (50+7+1+1 = authorized depth (ft) + required underkeel clearance + required overdredge (ft) + allowable overdredge (ft))." This is confusing because, aside from grammatical errors, it states -57 ft depth yet parenthetically adds up to -59. We assume -59 to be the appropriate contour to allow for comparable results.

Before evaluating the habitat areas for direct impact, mapping data were inspected to see if all habitats were captured in the county-wide NSU maps. In 2008, Broward County conducted a repeat lidar survey with higher resolution and better processing techniques. These data depicted the seafloor better than the 2001 data. A visual inspection of these data showed that several apparent hardbottom features were not included in the original 2004 NSU maps. It was also apparent that some of the habitat edges needed adjusting due to a difference in map scale. New polygons were created to delineate the new features evident in the lidar data. Since this was not a funded effort, no groundtruthing was performed on these areas, however the researcher performing the interpretation (Dr. Brian Walker) has over 10 years' experience translating bathymetric data into benthic habitats throughout southeast Florida with greater than 90% accuracy depicting hardbottom habitats. The areas are labeled "Previously Unmapped Hardbottom/Boulder" in the figures. Next the -59 ft contour was created from the 2008 lidar digital elevation model to use for the polygon edge. Separate non-overlapping hardbottom habitat polygons were depicted above and below this line and areas were calculated for each. Figure 2 depicts the final map of direct impacts within the channel including the previously unmapped areas.

Next, the potential direct impacts from the cutterhead dredge anchoring operation was determined by clipping the anchor impact areas to the updated map polygons and calculating the acreage of each habitat (Figure 3). This was not limited to certain depths like the previous analysis.

Finally, the indirect impacts were calculated for a scenario with anchoring (Figure 4) and without anchoring (Figure 5) in a similar manner.

# Attachment 3

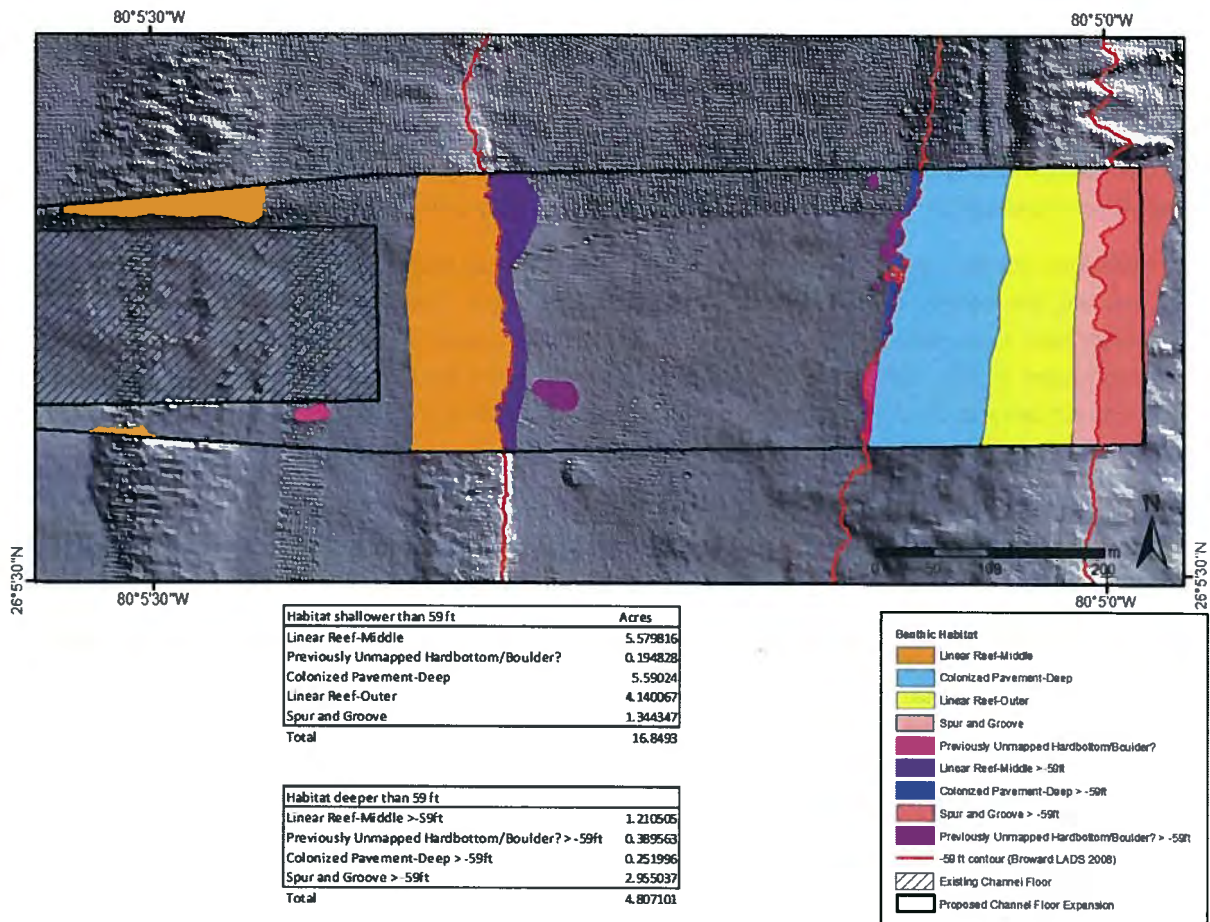


Figure 2. Updated habitat map with refined edges and previously unmapped hardbottom features within the proposed channel expansion area depicted. The red line is the 2008 lidar -59 ft contour. Areas are tabulated for all habitats shallower than -59 ft (top) and deeper than -59 ft (bottom).

### Attachment 3

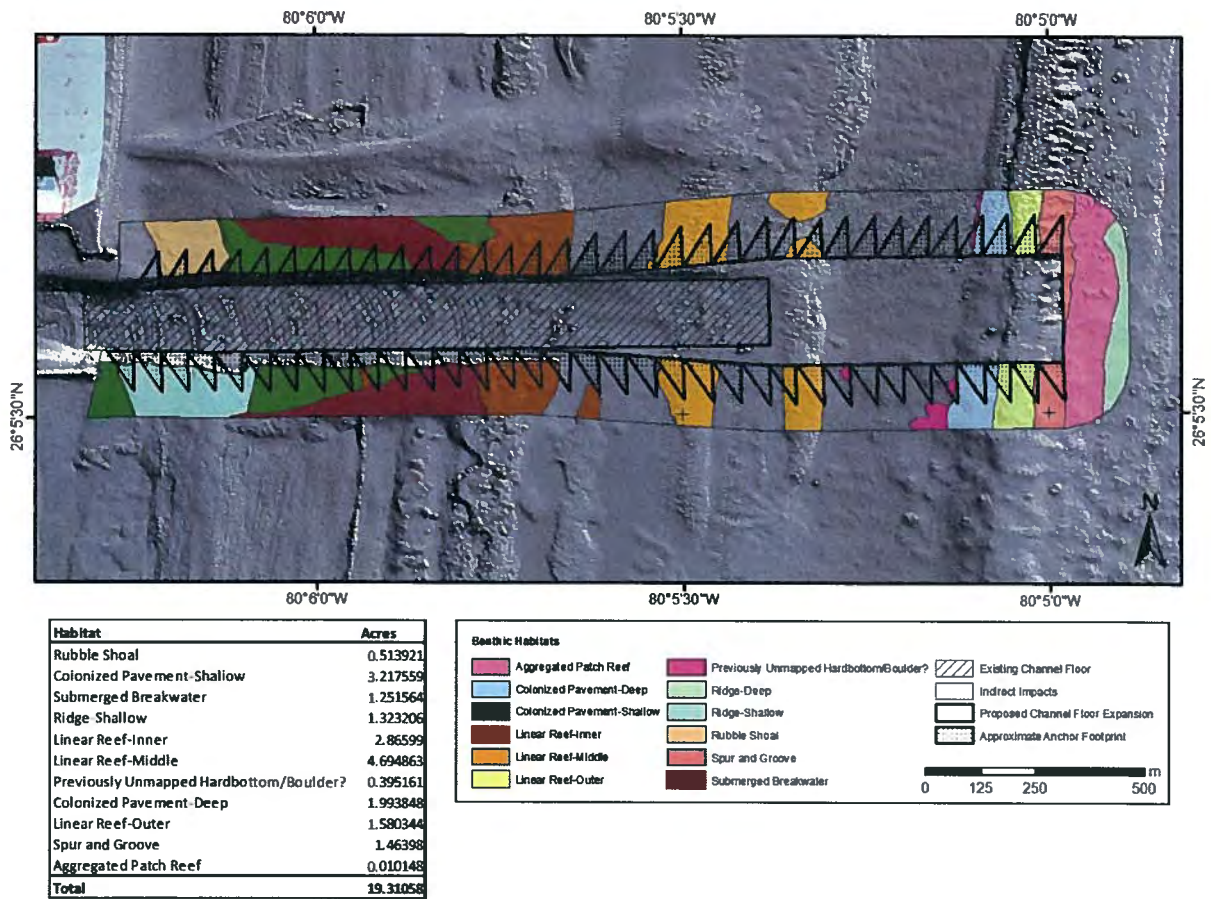


Figure 3. Updated map showing the potential anchoring impacts from a cutterhead dredge operation (habitats within triangles only). This map includes refined edges and previously unmapped hardbottom.

# Attachment 3

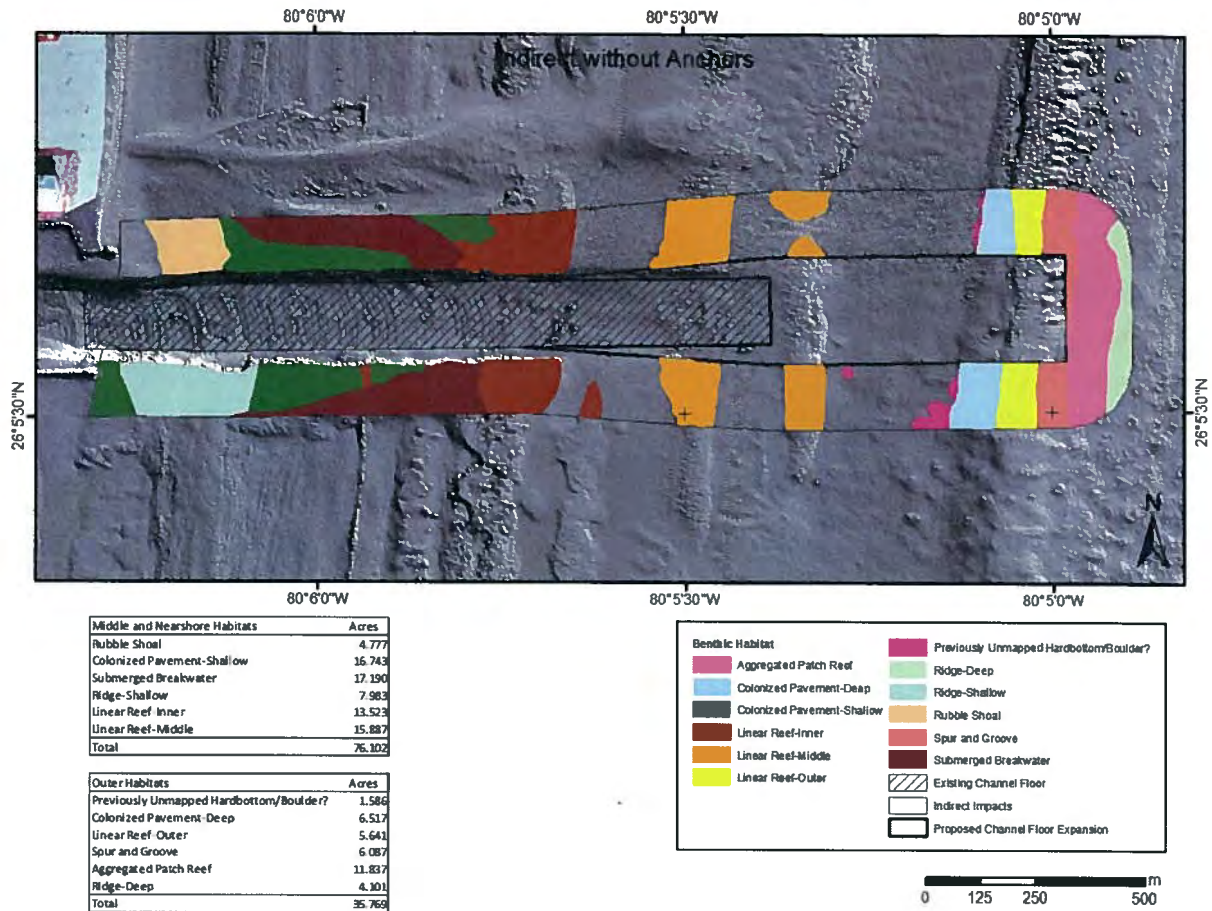


Figure 4. Updated map showing the potential indirect impacts dredge operation for scenario without anchoring. This map includes refined edges and previously unmapped hardbottom.

## Attachment 3

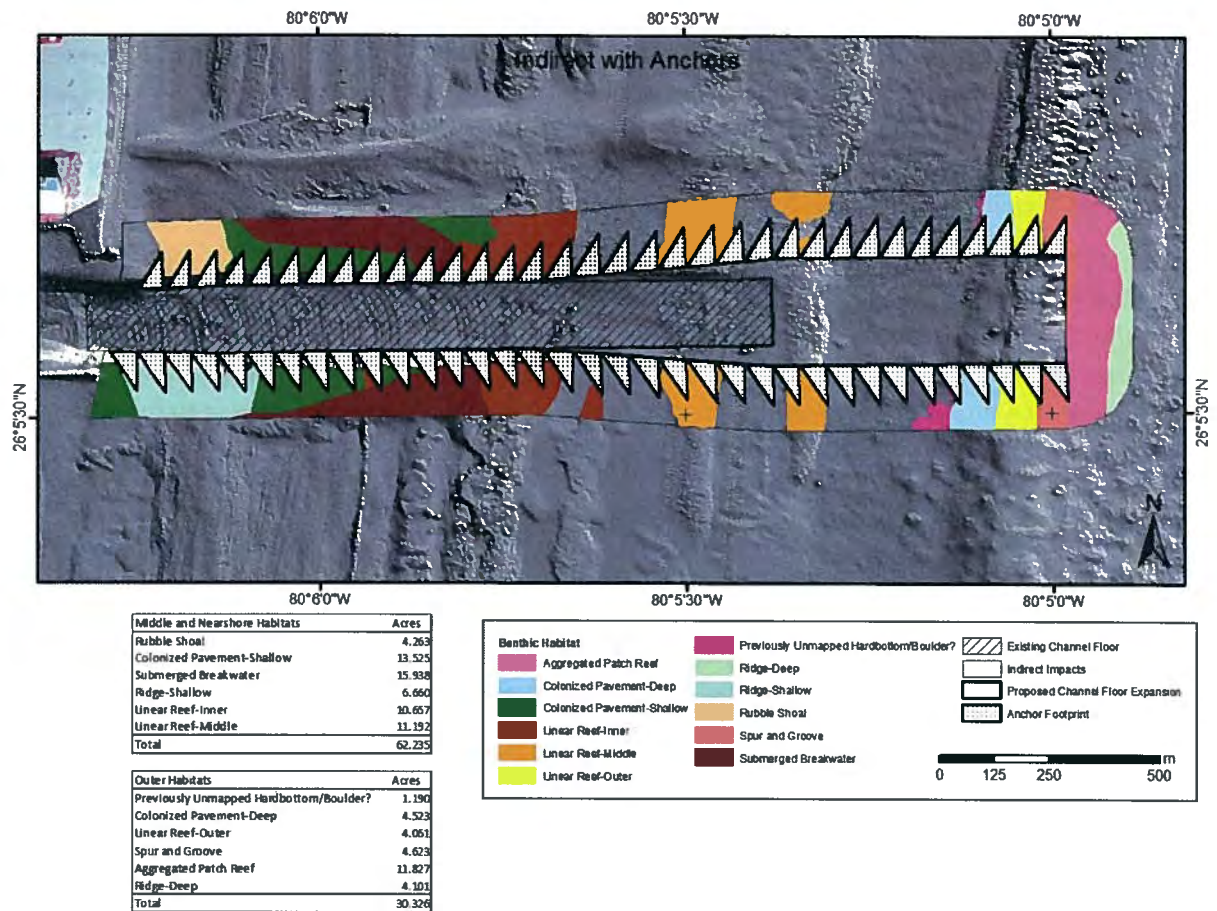


Figure 5. Updated map showing the potential indirect impacts from a cutterhead dredge operation with anchoring (habitats outside of triangles only). This map includes refined edges and previously unmapped hardbottom.

The results of our analysis differ from the EIS. Direct impacts in the channel shallower than -59 ft were 16.85 acres as compared to 16.64 acres reported in the EIS Scenario 1. Anchoring would create an additional 19.31 acres of impacts for a total of 36.16 acres for Scenario 2. The EIS reports 33.12 acres of impact for Scenario 2 which is 3.04 acres less.

The EIS reported Indirect impacts to the Outer Reef in Scenario 1 as 32.65 ac while we calculated 30.33 ac. We also found Scenario 1 Middle Reef impacts (62.24 ac) to be lower than reported in the EIS (63.46 ac). For Scenario 2 the EIS reported indirect impacts for Outer and Middle reefs as 37.69 ac and 75.55 respectively, while our analyses found 35.77 ac and 76.1 ac respectively.

### Data Integrity

The habitat mapping and impact area determination for the EIS and the appendices was not conducted consistently or properly. Reported impact areas were not consistent in the EIS and supporting documents which brings into question the reliability of the reported impacts and the mitigation

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estimations based on those numbers. The EIS and Appendix 2E use the -59 ft contour as the worst case scenario which are split into 2 depending on if anchoring will occur. On p. 177 and Table 19 of the EIS, it is reported that 16.66 acres of reef will be removed. Appendix 2E reports that 16.64 acres will be removed (p.12). Furthermore Table 1 Scenario 1 direct impacts total 16.43 acres. The HEA tables report 16.64. Given three values for the same impact does not instill much confidence that the correct value is being used. Should the HEA tables have used 16.66 acres?

Some of the discrepancies may have been from inexperienced GIS technicians. This also supports the idea that the habitat impacts were not calculated properly. After obtaining a polygon of the impacts from the USACE in Feb 2013 named “plan\_2e\_resource\_impacts\_sp83e.shp”, it was noted that polygons contained overlaps and gaps (Figure 6). These errors would propagate errors in the area calculations and subsequent HEA analyses and proposed mitigation amounts. There does not appear to have been any quality control steps taken to ensure data integrity.

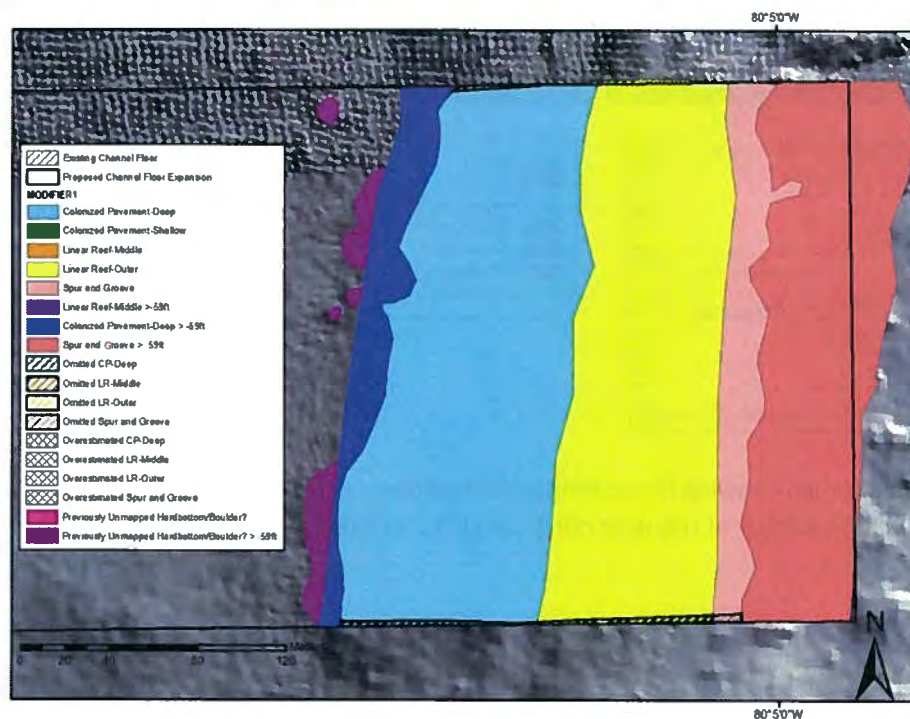


Figure 6. Map of outer reef polygons supplied by USACE in Feb 2013 showing sloppy polygon delineation with overlaps and gaps.

### Cumulative Impacts and Historic context of PE hardbottom communities

The draft EIS minimizes previous losses of hardbottom due to port construction activities by equating the proposed impacted amount (which is wrong according to Appendix 2E) to a percent of all the hardbottom in Broward County. Equating it to a percent makes the impacts seem much less. What's more relevant is the actual amount lost. Walker et al. (2012) published a peer-reviewed paper on the estimated historical losses of port and shipping activities in SE FL. They estimated that Port Everglades has historically dredged 58.5 acres of hardbottom and buried 178 acres of Outer Reef due to improper

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dumping of spoil material. Using county-wide mean coral density ( $2.6 \text{ m}^{-2}$ ) and percent cover (3.75%), historically PE development has impacted 6,149,000 corals equating to 180 acres of live tissue area. Using these same numbers, the direct impacts for scenario 1 will impact 380,000 corals with 1.36 acres of live cover and scenario 2 will impact 177,000 corals with 0.63 acres of live cover.

Furthermore the EIS does not describe any cumulative impacts for hardbottom. Although the effect of impacting 6 million corals is difficult to measure, it surely must've had some impact on surrounding communities. In addition, the burial of 178 acres of Outer Reef due to improper spoil disposal had a lasting effect on the system. This spoil remains in place today where rocks of all sizes are piled on the reef. These likely shift during high energy events and continually impact the local community. This is why the communities in the Dial Cordy 2009 benthic assessment are lower than the controls at the previously impacted sites.

Walker, B. K., Gilliam, D. S., Dodge, R. E., & Walczak, J. (2012). *Dredging and shipping impacts on southeast Florida coral reefs*. Paper presented at the Proceedings of the 12th International Coral Reef Symposium, 19A Human impacts on coral reefs: general session, Cairns, Australia, 9-13 July 2012.

**July 21, 2013**

Dear Tom and Jocelyn,

I've revised my comments to NOAA based on an analysis of the Appendix E2 Cost Analysis document of the DEIS that I did not have previously. Please disregard prior comments. The attached is still a working draft and may change based on the meeting in the coming week, but I think are pretty near final.

Best

Dick

**draft**

**Comments for NOAA's consideration for inclusion in their review of the ACE DEIS on:**

**DEIS Appendix E: Port Everglades Navigation Improvements- Draft Comprehensive Mitigation Plan and Incremental Cost Analysis**

**And**

**DEIS Appendix E2: Mitigation Requirements Analysis for Hardbottom Resources Associated with Port Everglades Harbor Navigation Improvements**

**Comment Summary:**

The DEIS gives details of the ACE's decision on extent of impact (direct and indirect) from dredging, and using their "modified" Habitat Equivalency Analysis (HEA), the type of and amount of the ACE chosen mitigation (boulders).

- The ACE uses incorrect amounts (areas) of impact, including by neglecting areas that will be directly impacted below the 57' dredging depth.
- The ACE uses an inappropriate 0% discount rate in its "modified" HEA. The HEA is an economic model and not intended to be used with a zero discount rate.
- The ACE choice of mitigation is boulders with coral transplants. These will not provide services upon maturity equivalent to those of the natural reef. The ACE has incorrectly assumed they will.
- The HEA inputs and results in Appendix E2 and not the same as those of the Cost Analysis.
- Many of the DEIS HEA input parameters used by the ACE are not supported by the best available science.

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- The inputs chosen by the ACE for their HEAs underestimate amount of mitigation required.
- An Alternate HEA has been developed as part of these comments using: corrected direct impact areas for the Outer and Middle Reefs to include the area below 57'; 3% discount rate; and corrected equivalence that boulders upon maturity reach 50% of services of the natural reef.
- The ACE DEIS HEA for Scenario 2 in the DEIS Appendix E Cost Analysis requires 32 acres less mitigation than the more correct Alternate HEA.
- Accordingly ACE project mitigation costs are significantly underestimated by using the underestimated mitigation amount.
- Table 9 of the Cost estimate there is no justification given for using a much small \$ amount for cost per acre of boulders with transplants.
- The ACE plan lacks input from the ACE's independent technical review performed by Battelle
- The NOAA recommended mitigation program is scientifically valid and preferred.
- The NOAA recommended mitigation program is more cost efficient than the ACE version, had ACE calculated their HEA with correct inputs.
- NOAA should be given responsibility for impact analysis, determination of mitigation type and amount, and implementation of the resultant program.

## Introduction

The entire DEIS, including the Mitigation/HEA Appendix E2, and the Mitigation Cost Analysis is extensive and complex. It is not possible to provide a complete analysis in the short comment period allowed.

The comments here will review aspects of the ACE impacts and mitigation findings, identify concerns, recalculate the HEA to show an example of appropriate amount of the ACE mitigation type using more proper inputs, and discuss other issues.

## ACE DEIS Impact & Mitigation:

The ACE DEIS in Appendix E2 presents results (for -57' dredging) for 5 categories of impact:

- Direct removal of Outer and Middle reef/hardbottom,
- Direct impact from placement of anchors and cables
- Direct impact to the channel wall
- Indirect effects of sedimentation and turbidity to the Middle Reefs.
- Indirect effects of sedimentation and turbidity to the Outer Reefs.

The results are framed in two scenarios. The scenarios are identical with the exception that Scenario 1 includes an estimate of direct impacts from Anchor and Cables while Scenario 2 does not include Anchor/Cable impacts. This is because the ACE states they do not yet know which

## Attachment 4

type of dredge will be used and the type of dredge will affect the degree of Anchor and Cable image. Scenario 1 is stated to be the worst-case effects and Scenario 2 is the least case effects for this category of injury.

Only results for Scenario 2 are presented in the ACE DEIS Appendix E Cost Analysis and Direct impact from Anchors and Cables are omitted. The Cost Analysis uses different HEA assumptions for the Direct removal impact.

The ACE states that mitigation for only the direct impacts on the Outer and Middle reef will be conducted initially. Mitigation for other impacts (Anchor and Cable direct and other impacts from sedimentation/turbidity) will be conducted after a post-hoc survey is accomplished to quantify that impact.

The comments to follow a detailed discussion of results of the DEIS Appendix E Cost Analysis Scenario 2 four categories of Impact in Scenario 2: direct impact to the Outer and Middle Reefs, Direct to Mid Channel Wall Impacts, Indirect Outer reef impacts and Indirect impacts all other habitats.

Scenario 1 potential direct Impact from Anchors and Cables while not included in the DEIS Cost Analysis will also be discussed.

### **Habitat Equivalency Analysis (HEA) to Determine Amount of Mitigation.**

There are many parameters that need to be included in an HEA to best determine the amount of compensation necessary. The following table provides the HEA parameters and their values used for the ACE DEIS HEA (of Appendix E Cost Analysis) and for the Alternate HEA calculated for these comments.

Nearly all ACE parameter values are used in the two HEAs. There are three that change in the Alternate HEA. These are highlighted in Yellow.

**TABLE 1**

<b>INJURY: Direct to Mid Outer Reefs</b>	<b>HEA Input</b>
Pre-injury service level	100%
Degree of service lost of resources immediately following injury (mortality)	100%
Equilibrium level to which recovery can reach	15%
Injury recovery time to equilibrium (years)	50
<b>COMPENSATORY ACTION: Boulders w/Transplants</b>	
Pre-restoration service level	0%
Service level of CA upon initial installation	10%

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Equilibrium level of service From CA expected	100%
Time for services to develop from installation to equilibrium	30y 0%-100%, then 20y at 100%
<b>COMMON to INJURY &amp; COMPENSATORY</b>	

<b>INJURY: Direct to Channel Wall</b>	<b>HEA Input</b>
Pre-injury service level	100%
Degree of service lost of resources immediately following injury (mortality)	100%
Equilibrium level to which recovery can reach	95%
Injury recovery time to equilibrium (years)	26
<b>COMPENSATORY ACTION: Boulders w/Transplants</b>	
Pre-restoration service level	0%
Service level of CA upon initial installation	10%
Equilibrium level of service From CA expected	100%
Time for services to develop from installation to equilibrium	26

<b>INJURY: Indirect Outer and All Other Habitats</b>	<b>HEA Input</b>
Pre-injury service level	100%
Degree of service lost of resources immediately following injury (mortality)	100%
Equilibrium level to which recovery can reach	98%
Injury recovery time to equilibrium (years)	3
<b>COMPENSATORY ACTION: Boulders w/Transplants</b>	
Pre-restoration service level	0%
Service level of CA upon initial installation	10%
Equilibrium level of service From CA expected	100%
Time for services to develop from installation to equilibrium	50

<b>COMMON Parameters to INJURY &amp; COMPENSATORY</b>	<b>HEA Input</b>
# of injured area units	ACE, NOAA
Date of Injury/ Date of Compensatory Action	2012
Discount rate per time unit	0%, 3%
Shape of recovery trajectory/ trajectory to equilibrium =	Linear
Value-injured/value restored= 1/	1., .50
End of HEA Calculations	Non-In perpetuity, i.e, to times shown above

The only parameter values that are different between the ACE HEA and the Alternate HEA are the:

- Extent of impact

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- Discount Rate
- Equivalence of the impact area (natural reef) to the compensatory action (the boulders).

Other values for other HEA parameters should be considered and will be discussed later.

### Amount of Impact

The ACE as discussed by NOAA and others has used an incorrect amount of acreage impact for Middle and Outer Direct Impact (and for potential Anchor/Cable impact). The ACE only considers the direct impact amount ABOVE 57 depth. Nevertheless, habitat will be destroyed below 57' and needs to be included. For Middle and Outer Reefs there are significant deeper than 57' reef portions that will be directly affected by dredging generated rubble and subsequent rubble mobility. NOAA provides a cogent analysis that the reef areas below 57' should be treated as direct injury.

The ACE has determined the amount of Outer and Middle reef area to be destroyed above 57' to be 15.17 acres. NOAA has determined that impact to the Middle and Outer reefs when taking into account the amount of affected reef area below 57' is a total of 21.65 acres. The corrected acreage impacts have an increase of over 5 acres in direct impact to Middle and Outer Reefs.

### Discount Rate

#### Use of 0% Discount Rate

The DEIS states that by law the ACE is permitted to only use a 0% discount rate in their HEA calculations.

However, page 29 of the DEIS Appendix E2 has the following statement:

*"As previously stated, Under Office of Management and Budget Circulars A-4 and A-94 (Regulatory Analysis and Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs, respectively), when federal agencies are determining costs and benefits of a federal water resources development project, no discounting should occur (emphasis added). Specifically Circular A-94 states "Specifically exempted from the scope of this Circular are decisions concerning water resource projects (guidance for which is the approved Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies." The Port Everglades Feasibility Study, and all of the components of that study, falls under the aforementioned water resource principles and guidelines."*

The statement seems to clearly indicate that the current project under consideration is exempt from the "no discounting" rule. This would mean discounting is permissible. Review of

## Attachment 4

circulars A-94 and A-4 does not seem to require the Corps use a 0% discount rate. In fact the circulars discuss the use of a variety of non-zero discount rates.

The HEA method was designed to be used with a finite discount rate. The use of a finite discount rate is discussed in any HEA explanation in the literature. A good example is the document by Ray (Ray, G. L. 2007. Habitat equivalency analysis: A potential tool for estimating environmental benefits. EMRRP Technical Notes Collection (ERDC TN-EMRRP-EI-02). Vicksburg, MS: U.S. Army Engineer Research and Development Center). The explanation clearly cites the HEA's use of and NOAA's rationale for a finite discount rate.

The mitigation document (DEIS Appendix E2) in fact also explains the need for using a finite discount rate on page 2: *"Therefore, the quantities of ecological services occurring at different times are not valued on an equivalent basis and must be adjusted before they can be compared in a meaningful way. This adjustment process, known as discounting, permits one to examine quantities occurring at different times on a comparable basis."*

### Use of 3% Discount Rate

It is common practice to use a 3% Discount Rate (DR) in an HEA. NOAA (and others) recommends this amount in published literature. The HEA prepared of the DEIS does not utilize a discount rate (more properly it uses a 0% discount rate) for the calculations. The ACE refers to their method as the "modified HEA". Use of a 0% Discount Rate will provide a lower amount of mitigation in comparison to results using a Discount Rate above 0%.

The Alternate HEA presented below uses a 3% Discount Rate as recommended by NOAA.

It is noted that the ACE uses a Discount Rate of 3.75% in their Economic Analysis of the DEIS.

### Degree of Equivalency Between Natural Reef and Mitigation (Boulders)

The assumptions of an HEA require that the type of compensatory action (= mitigation) chosen be equivalent to the habitat being injured. The DEIS clearly states this necessity in Appendix E that the services of the habitat of injury should be *"ecologically equivalent to the service that will be provided by the replacement habitat"*. Otherwise a factor must be applied to create equivalency.

The DEIS choice of mitigation for impacts to the reef are piles of boulders. The DEIS assumes that the compensatory action choice of boulders, upon maturity, will have identical services as the natural reef to be impacted.

There is literature which indicates that artificial reefs, including those composed of boulders, are not equivalent to those of natural habitat. For example, Miller et al. (2009) documented an

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overall lack of similarity between natural reef and artificial reef assemblages. Gilliam (2012) concluded the length of time boulder reefs require to mitigate lost reef resources in southeast Florida, assuming a total loss of the impacted community from events such as dredging, exceeds the age of the oldest boulder reef assessed in this study (17 years). Kilfoyle et al. (2013) show nearshore natural and artificial hardbottom habitats have dissimilar usage by the early life history stages of species managed under the fishery management plan for snappers and groupers. Statistically significant higher abundances occurred on natural nearshore hardbottoms compared to the artificial habitat

While the above references do not specify the exact degree of dissimilarity, it is safe to say there is not 100% equivalence. This assumption is valid in the “smell test” of logic. A pile of boulders is not a coral reef and will not over time become a coral reef. Therefore the boulders will provide lower degree of habitat services compared to those of a coral reef.

A more reasonable approach would be to consider that the ratio of the services of the natural reef to a pile of boulders upon reaching equilibrium) would be on the order of  $1.0/0.50 = 2.0$ . In other words, upon maturity boulders would provide 50% of the services as the natural reef.

Table 1 below gives the results of the ACE Appendix E Cost Analysis HEA compared to the Alternate HEA using corrected impact numbers for all categories, a 3% Discount Rate, and corrected equivalence of natural reef to boulders:

## Attachment 4

**Table 1: Comparison of ACE DEIS Cost Analysis HEA to Alternate HEA**

Scenario 2 Impact Amount & Mitigation Requirement  in acres For dredging to -57'	ACE DEIS IMPACT -57	ACE DEIS MITIGATION	NOAA Corrected Impact -57'	ALTERNATE MITIGATION Using NOAA Corrected IMPACT, 3% DR, & Reef/Comp ratio= 1/.5= 2
Impact in Acres Category				
Middle and Outer Reef Direct Impacts	15.17	19.05	21.65	50.103
Middle Reef Channel Wall Impacts	0.36	0.32	0.36	0.61
Direct Anchor and Cable Impacts	0	0	0	0
Outer Reef Indirect Impacts -Construction	37.69	0.04	41.78	0.155
Middle/nearshore Impacts – Construction	75.55	0.08	78.25	0.289
<b>Total Requirement</b>		<b>19.49</b>		<b>51.158</b>

For Scenario 2, the DEIS Cost Analysis HEA results in 19 mitigation acres. The Alternate HEA results in 51 acres.

DEIS Cost Analysis HEA results are near 32 acres underestimated.

The DEIS ACE “modified HEA” underestimates the mitigation required by using an incorrect 0% discount rate, a lower than accurate impact area, and an incorrect comparison of the level of services of the boulders upon maturity as compared to a natural reef.

The clear driver in the total Requirement is the amount of impact to the Middle and Outer Reefs. Results for the other categories are lower than appropriated due to poor choice of other input values and should be recalculated using more correct values to be discussed later.

## Cost Calculation

#### Attachment 4

The main DEIS document states on page 259 “The total estimated cost for this alternative, which includes the cost of coral translocation, is estimated at \$20.13M. Details can be found in Appendix E comprising the mitigation plan and related sub-appendices.”

Appendix E Cost estimation is NOT easily found on the Web version of the DEIS. However, it is on the CD version.

Had proper inputs to the ACE DEIS HEA been used the amount of mitigation required and associated costs would have been much higher and much greater than the costs of NOAA’s preferred alternative. This is illustrated below in Table 2

**Table 2: Mitigation Cost Comparisons of ACE result to the Alternate HEA**

	Cost with ACE Table 8	Cost with Corrected Area	Cost with Corrected Area & Cost/Acre
Total mitigation area (acres) required to offset impacts	19.49	51.16	51.16
Cost per Acre	\$588,524	\$588,524	\$1,225,000
Coral Relocation (Not more than 12,235 colonies) (included above)	\$8,662,380	\$8,662,380	\$8,662,380
<b>Total Mitigation Cost</b>	<b>\$20,132,713</b>	<b>\$38,771,267.84</b>	<b>\$71,333,380.00</b>

In the DEIS Appendix E Cost Analysis, the last column of Table 8 presents an area of 19.49 acres of mitigation multiplied by a cost of \$588,524 per acre plus \$8,662,380 for a total cost of \$20,132,713. This is shown above in Table 2 in column 1.

With proper HEA inputs of the Alternate HEA, the mitigation area should be 51.16 acres. Using the ACE cost estimate \$588, 524 per acre plus \$8,662,380, the revised total cost is: \$38,771,268.

The Cost/Acre figure of \$588, 524 in the ACE DEIS Cost Estimate Table 8 provided for boulder mitigation and coral transplants is not justified. This figure stands in stark contrast to the cost/acres of other and similar options which are \$1.2M. Without justification, the \$588, 524 number appears artificially deflated. Instead, using the \$1,225,000 cost /r acre estimate provided in Table 8 for essentially the same mitigation (boulders with coral transplants placed on top of tires), the total cost is **\$71,333,380.!**

It should be noted that the DEIS stated the cost of the NOAA NMFS mitigation recommendation is estimated to cost approximately \$35.6M to \$42.3M (including risk contingencies). **Hence the NOAA NMFS plan is significantly less than the ACE plan had it been correctly calculated.**

## **Indirect Impact Mitigation Calculations**

The DEIS in Appendix E2 and in the Cost Estimate say that amount of mitigation (and hence the costs) for indirect Impacts will not be calculated prior to construction. Surveys will be taken after construction to determine the amount of impact and this will be used to determine the amount of mitigation. The ACE then takes an inconsistent approach and in fact estimates indirect impact and potential direct impact.

In DEIS Appendix E2, the ACE HEA Scenario 1 includes direct impact from the Anchors and Cables that may be needed depending on the type of dredge as well as the indirect from sedimentation and turbidity. It also includes the direct impact from the Channel Wall as well as the indirect from sedimentation/turbidity. In the Cost Estimate, however, the impact from Anchors and Cables is excluded.

There are several problems with this approach.

First the Anchors and Chains impact should be included as a contingency. The ACE has had enough experience with dredging to be able to reasonable include a probability factor about the kind of dredge to be used. The amount of Anchor and Chair mitigation as shown in Table 17 of Appendix E2 is large (7.83 acres) and would be even larger if calculated with the correct inputs. The ACE has inexplicably considered the impact on the footprints to be only 50%. It would likely be 50% with complete removal of all living organisms. A more correct 100% injury as well as the other inputs used in the Alternate HEA (3% discount rate, proper equivalence of boulders to natural reef) should have been used to calculated possibly needed mitigation.

Second the impacts associated with sedimentation and turbidity have been predicted by the ACE to be miniscule (2%) and only to last 3 years. The dredging itself is predicted by the ACE to last up to 5 years. There is likely to be injury associated with the sedimentation and turbidity, it will not instantly be healed upon cessation. There will be lasting effects. Hence the mitigation for these categories is substantially underestimated. The DEIS uses too low of an estimate of impact (2%) and recovery time (3 years) for their HEA. These estimates should be revised upwards (e.g on the order of 15% and 50 years) to be more accurate and thus to provide for contingency funds for mitigating likely indirect impacts.

The ACE state the amounts of indirect impacts will be determined by post-construction monitoring and these will determine the amount of mitigation. However, it is unclear if the DEIS cost estimate includes sufficient amounts of funds to be available if for mitigation if needed.

**An accurate estimate of the amount of direct impacts of Anchor and Cables and indirect impacts of sedimentation and turbidity should be conducted so that accurate costs can be determined and contingency funds made available to secure additional mitigation if needed.**

### **Support for NOAA mitigation plan**

The DEIS Appendix E2 includes “5.2.3 Preferred Reef Mitigation Alternative 2 (NMFS-Developed Plan)”

NOAA NMFS has been a cooperating agency with USACE for development of the Environmental Impact Statement (EIS) and has independently estimated that the tentatively selected plan impact. NOAA NMFS recommends mitigating these impacts by propagating coral colonies at in-water and land-based nurseries and then outplanting the colonies to suitable recipient sites in Broward County’s offshore waters. NMFS estimated that this approach would require approximately 20 years to complete and would cost approximately \$35.6M to \$42.3M (including risk contingencies). This cost is less than the ACE plan when the ACE plan calculated correctly.

NOAA NMFS’s recommendation is preferable to the ACE plan and is based on successful and scientifically valid coral propagation and enhancement programs in Atlantic and Caribbean waters, including those of the project area, Broward County.

The plan involves establishing a stock coral population in on-land and off-shore nurseries. The physical and genetic origin of each coral will be tracked to ensure that both nursery and outplanting operations are scientifically responsible. Regular maintenance will be performed on nursery structures and the corals. When nursery corals have grown to an appropriate size for high probability of survival on natural reefs (e.g., usually requires 12 to 18 months), the corals will be outplanted.

Species to propagate and outplant will include staghorn coral and other species based on findings from recent coral restoration studies, historical survey data, and results of monitoring.

Recipient sites would include those to maximizes likelihood of survival and minimize risk from human disturbances.

NOAA will also include replacement of lost 3-dimensionality using corals and artificial reefs in their plan.

In addition to eventually establishing those colonies on recipient sites, NOAA NMFS assumes that additional coral translocation will occur as an impact minimization measure and that such costs will be included in the budget for minimization.

## Attachment 4

The NOAA program including coral propagation and outplanting program is based on existing NMFS coral recovery programs, partnership with local resource agencies (e.g., FDEP), academic institutions (e.g., NSUOC), and others in Florida. The alternative is designed to maximize the chances of successful coral reproduction; larval transport; settling and colonization areas; and genetic mixing. The proposal is consistent with the NMFS Acropora Recovery Strategy (under development) and for other coral species proposed to be listed under the Endangered Species Act.

NOAA should be given responsibility for impact analysis, determination of mitigation type and amount, and implementation of the resultant program.

### **Inaccuracies and Inconsistencies:**

The Abstract results of the main DEIS is not consistent with those presented in DEIS Appendix E2.

The Appendix E2 HEA inputs are inconsistent with the HEA inputs of the Appendix E Cost plan.

### **Indirect Impact Monitoring**

Monitoring for determination of the extent of indirect impacts is insufficient to accurately determine effects. The proposed sampling design presented is sketchy and does not provide a power analysis that will allow determination of sample size needed to detect differences of various amounts.

### **Battelle**

**P 4 of the DEIS states**“... the outcomes presented in this report were calculated with input values selected by USACE in consultation with DC&A. DC&A, in association with the Battelle Memorial Institute, developed these input values for these HEAs using peer-reviewed scientific literature, ...”

There is no reference given to Battelle contribution. Battelle did review the Corps mitigation plan and found issues with Corps choice of parameters.

### **Time for recovery**

**P4 Corps states**“ For the purpose of the Port Everglades HEA, the method employed by the Corps uses a Landscape HEA with stony corals as the representative proxy for the entire habitat

## Attachment 4

affected. While stony coral coverage is <1% in the project footprint and vicinity (Gilliam *et al.* 2004, DC&A 2008), we did not use a proportional analysis to calculate the coral impacts. Instead, the losses are calculated as the amount of time it would take for the slowest-growing members of the ecosystem, in this case the stony corals, to recover to baseline, for the entire project footprint.”

This is worth noting for discussion of recovery rates. The ACE has used 50 years for direct impacts and for the compensatory action (boulders) to reach maturity. These time estimates are likely underestimated given the age of oldest corals in the vicinity in excess of 100 years. 100 years for recovery is preferred.

### Counting Avoidance Minimization as Mitigation

The Corps is assigning their 50 year recovery rate to boulders by including a factor due to transplantation of corals from the impact area to them. In the Cost Estimate a time of 30 years to maturity (100% is assigned that persists to 50 years.

This time reduction is inappropriate. The first step in impact analysis is avoidance and minimization. Avoiding impact by removing corals from the impact site minimizes impact. As an example, one way to determine the reduction of injury impact would be to calculate the total number of corals that would be killed from the Direct Impacts to the Outer and Middle Reefs.

DEIS Appendix E2	Corals Killed with no removal
Middle Reef Corals	10,801.0
Outer Reef Corals	89,943.0
Total	100,744.0

DEIS Cost Estimate	Corals to be Removed
Mid & Outer Reefs	12,235.0

% impact reduction	12.14%
--------------------	--------

Using information from the DEIS Appendix E2, the total number to be killed is 100,744. The DEIS Cost estimate indicates up to 12,235 would be removed. Thus this would be a 12% reduction of impact.

#### Attachment 4

Even if the translocated corals are used for reduction of time to maturity for the ACE choice of mitigation, such credit for discussion purposes at the Core groups meetings was only 10 years.

For a conservative approach, assume that the correct recovery rate is 75 years. Taking off 10 years for the contribution to recovery rate would be a recovery period of 65 years. This was used as a reasonable assumption by the Core Group.

It is telling that the DEIS uses 50 years in Appendix E2 and 30 years in the Cost Estimate. This gives the appearance of juggling the recovery figures as HEA inputs to minimize HEA outputs.

## Attachment 5

		Size (Acres)	Project	Relative Functional Gain (RFG)	Mitigation Credit (FG)	Management Items
I. Master Plan - ESTIMATED MITIGATION CREDIT FOR WEST LAKE PROJECT						
A. Physical Habitat Alteration						
1	Structural habitat along the Intracoastal Waterway ICWW	1.9	Structure/ fill			
2	<del>Mangrove protection and enhancement by riprap placement</del>	<del>24.0</del>	<del>Enhancement</del>	<del>0.26</del>	<del>6.24</del>	
3	Supplemental structural habitat along Dania cut-off Canal	2.0	Structure/ fill			
4	<del>Mangrove protection by riprap supplement</del>	<del>8.0</del>	<del>Enhancement</del>	<del>0.26</del>	<del>2.08</del>	
5	Nuisance/Exotic Plant Control	8.4	Enhancement	0.11	0.92	
6	Spoil island and exotic dominated upland areas conversion					
6a	<del>Mangrove</del>	<del>22.2</del>	<del>Creation</del>	<del>0.47</del>	<del>10.43</del>	
6b	Mud Flat/tide pool	7.0	Creation	0.65	0.14	
6c	Channel	8.6				
6d	Seagrass	8.0				Creation
6e	Maritime Hammock	13.4	Creation	0.23	3.08	
7	<del>Mangrove creation from Dania Cutoff Canal (open water)</del>	<del>22.0</del>	<del>Creation</del>	<del>0.21</del>	<del>0.42</del>	
B. Land Acquisition (within existing park)						
1	Outparcel Acquisition					X
2	Vacate utility easements					X
3	Vacate FINE easements					X
4	<del>Outparcel Acquisition (OUTSIDE IMPROVEMENT AREAS)</del>	<del>23.3</del>	<del>Preserv.</del>	<del>0.06</del>	<del>1.40</del>	
C. Habitat Improvements						
1	Creation of Mantee Protection Areas					
1a	<del>Seagrass/manatee protection area in Whiskey Creek (WC)</del>	9.0	Preserv.	0.03	1.0	Seagrass
1b	<del>Seagrass/manatee protection - ICWW south of Dania Beach Blvd.</del>	21.0				Seagrass
2	Enhance/protect bird nesting, and feeding habitat					X
3	Establishment of Osprey towers					X
4	Mud flat/tide pool creation from Brazilian pepper areas in Dania Salt Marsh	1.5	Restoration	0.22	0.33	
5	Protect/preserve sea oxeye fields from exotic invasion	10.0	Enhancement	0.22	2.20	
D. Hydrologic Improvements						
1	Dania Salt Marsh (DSM)/flushing channel improvements	3.5	Enhancement	0.22	0.77	
2	Desilt existing culverts					X
3	Increase number of or upsize culverts					X
4	Desilting channels/ongoing maintenance dredging					X
E. Miscellaneous Improvements						
1	Remove the barges at Whiskey Creek (expose bottom for SAV recruitment)	0.5	Enhancement	0.08	0.04	Seagrass
	TOTAL	174.30				
	Mangrove Mitigation Credits				20.57	
	Seagrass Mitigation				2.22	
	Other Mitigation Credits				17.45	

US Army Corps  
of Engineers

File # SAJ-2002-72(IP-LAO)

ATTACHMENT 6 (NOTE: This refers to the Corp's file)

**Seagrass UMAM data done by transect numbers**

**Landscape**

PE-8 - 8

PE 10 - less connectivity, smaller bed less fish and wildlife service benefits. Landscape score – 6

PE-1 - 8

P34 – Landscape 8

PE 33 – Landscape 6

P35 – Landscape 6(lumped with PE10)

P32 – (0.acres) Landscape 6 (lumped with PE10) \*2

PE24/PE25 (0.6 acres) - Halodule wrightii; sparse coverage – Landscape – 8

PE-19 – Johnsonii bed - .05 acres – very small; next to John U Lloyd park – 6

PE-17 – .13 acres/.05 acres - larger bed – mixed species; higher community level - 7

PE-12, 13, 14, 15 - .84 bed; larger bed; across from Westlake park – 8. Health dense beds; high contiguous

D16 – 7

**Water**

Water area #1

Transects - #8, 10, 1, 35, 34, 35 – Water score – 7

Water area #2

Transects - #33, 32 – Water Score – 8

Water area #3 –

Transects #25, 24, 19, 17 – Water Score – 6

Water area #4 -

Transect – 12, 13, 14, 15 – Water Score – 8

Water area #5 – Dania CutOff Canal

Transect D16 – Water Score – 6

water quality changes every 6 hours.... In and out – every 6 hours. Poor water quality followed by good water quality.

Sand bottom is a limiting factor; light is major limiting factor.

**Community Structure -**

Jocelyn completely disagrees with the way this section was scored, will formally address

PE-8 – Sparse bed – 4

PE-10 – 3-4% coverage; not as much diversity; solitary shoots w/no coverage – 2

PE-1, 2, 3 – 10% coverage; abundance is .3 (impact area); solitary blades.... Center of bed is 5% with edges very sparse – 3

PE-35 – 1% coverage – 2 (just like 10)

PE-34 – 25% coverage johnsonii – just under 5% density – 7.

PE 33 – no grass found in the quadrats - 2

PE 32 – higher coverage than PE 35 – 22% quadrants and 1.75% numerous shoots – 5-25% cover – 4

PE 24-25 – *Halodule wrightii*; few shoots,  $\frac{1}{4}$  to  $\frac{1}{8}$  coverage – 3

PE-19 – no grass found in quadrats – 2

PE-17 – 5

PE – 12, 13, 14, 15 – 8 (bed across channel from 12, 13, 14, 15)

D16 - 2



REPLY TO  
ATTENTION OF

DEPARTMENT OF THE ARMY  
JACKSONVILLE DISTRICT CORPS OF ENGINEERS  
P.O. BOX 4970  
JACKSONVILLE, FLORIDA 32232-0019

Planning Division  
Environmental Branch

184 JUN 2013

Virginia Fay  
Asst. Regional Administrator  
NMFS-SERO-HCD  
263 13<sup>th</sup> Ave South  
St. Petersburg, FL 33701

Pursuant to the National Environmental Policy Act (NEPA), this letter constitutes the Notice of Availability of the Draft Feasibility Study and Environmental Impact Statement (EIS) for the Proposed Navigation Improvements at Port Everglades Harbor, Broward County, Florida. This letter also serves to convey the EFH Assessment incorporated in the project EIS.

The draft Feasibility Study and EIS are available for viewing on USACE's website under the project name Port Everglades Feasibility Study at  
["http://www.saj.usace.army.mil/About/DivisionsOffices/Planning/EnvironmentalBranch/EnvironmentalDocuments.aspx#PE"](http://www.saj.usace.army.mil/About/DivisionsOffices/Planning/EnvironmentalBranch/EnvironmentalDocuments.aspx#PE).

The District initiated coordination with NMFS under the EFH provisions of the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) through the March 5, 2001 NEPA scoping letter and a response to that Scoping letter from NMFS dated April 26, 2001. Per the May 3, 1999 EFH Finding between NMFS and the USACE-Jacksonville District, the EFH Assessment for the project is integrated within the Draft EIS. Per the 1999 Finding, the February 2004 "Preparing Essential Fish Habitat Assessments: A Guide for Federal Action Agencies" document and 50 CFR 600.920(e)(3), an EFH Assessment must include the specific items. Each item will be addressed in the table below with a reference to where the information is located in the EIS.

EFH Required Item	EIS Location(s)
Description of the Proposed Action	What is the action? - <i>Section 1.1 - Project Objective</i> - <i>Section 2.2 - Objectives</i> What is the purpose of the action? - <i>Section 1.3 - Project Need</i> How, when and where will it be undertaken? - <i>Section 2.9 - Construction of the Tentatively Selected Plan</i> What will be the result of the action? - <i>Section 2.3.2 - Recommended Alternative/Tentatively Selected Plan</i>
Analysis of the potential adverse effects (individual and cumulative) of the action on EFH and the management species	What EFH will be affected by the action? - <i>Section 3.6.3 - Essential Fish Habitat</i> - <i>Section 3.5.2 - Wetlands (Mangroves)</i>

	<ul style="list-style-type: none"> <li>- <i>Section 3.6.1 – Seagrass Communities</i></li> <li>- <i>Section 3.6.2 – Hardbottom and Reef Communities</i></li> <li>- <i>Section 3.6.4 – Other Fisheries Resources</i></li> <li>- <i>Section 3.7.2.13 – Staghorn &amp; Elkhorn corals</i></li> <li>- <i>Section 3.7.2.14 – Corals Proposed for Federal Protection</i></li> </ul> <p>What are the adverse effects to EFH that could occur as a result of this action?/ How would they impact managed species?/ What would be the magnitude of effects?/What would the duration be?</p> <ul style="list-style-type: none"> <li>- <i>Section 4.3 – Wetlands (Mangroves)</i></li> <li>- <i>Section 4.4.1 – Seagrass Communities</i></li> <li>- <i>Section 4.4.3 – Essential Fish Habitat</i></li> <li>- <i>Section 4.4.4 – Other Fisheries Resources</i></li> <li>- <i>Section 4.5.2 – Johnson’s seagrass</i></li> <li>- <i>Section 4.5.10 – Staghorn &amp; Elkhorn corals</i></li> <li>- <i>Section 4.5.11 – Corals proposed for federal protection</i></li> <li>- <i>Section 4.29 – Cumulative Impacts (Specifically 4.29.6)</i></li> </ul>
Proposed Mitigation	<p><i>Section 5.2 – Proposed Mitigation</i></p> <p><i>Appendix E – Mitigation Plan</i></p>

Additionally, the Guidance states that for projects that may have substantial impacts on EFH, additional information may be necessary. These additional items are addressed throughout the EIS and the information provided in the table below.

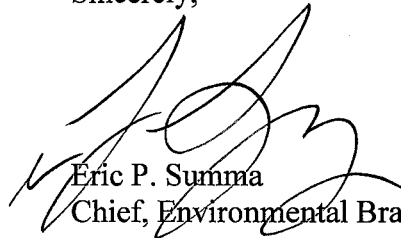
<b>EFH Additional Information Item</b>	<b>EIS Location(s)</b>
Results of on-site inspections to evaluate the habitat and the site-specific effects of the project	<ul style="list-style-type: none"> <li>- <i>Section 3.5.2 – Wetlands (Mangroves)</i></li> <li>- <i>Section 3.6.1 – Seagrass Communities</i></li> <li>- <i>Section 3.6.2 – Hardbottom and Reef Communities</i></li> <li>- <i>Section 3.6.4 – Other Fisheries Resources</i></li> <li>- <i>Section 3.7.2.13 – Staghorn &amp; Elkhorn corals</i></li> <li>- <i>Section 3.7.2.14 – Corals Proposed for Federal Protection</i></li> <li>- <i>Appendix D – Natural Resource Reports</i></li> </ul>
Review of pertinent literature and related	<i>Literature cited throughout EIS, Natural</i>

information	<i>Resource Reports, Mitigation Plan and ESA Consultation package with NMFS (for listed and proposed corals and designated critical habitat which are also EFH).</i>
-------------	--

The District has determined that the effects of the construction of the Proposed Navigation Improvements at Port Everglades Harbor, Broward County, Florida may adversely affect designated essential fish habitats and habitats of particular concern. The magnitude of the impacts will vary based on the type of habitat ranging from temporary and insignificant to substantial and permanent. Impacts have been avoided and minimized significantly since the project was originally coordinated under NEPA through the proposed in 2001, remaining impacts to habitats are unavoidable. Impacts to mangroves have been reduced by 98%; and impacts to hardbottom & reef communities have been reduced by 58%. Impacts to seagrasses have changed over the project life, not due to changes in project footprint, but due to the ephemeral nature of these specific grass species.

Please provide all comments under NEPA and the MSFCMA to the Draft Feasibility Study and EIS by August 13, 2013. If you have any questions, please contact Mrs. Terri Jordan-Sellers at 904-232-1817 or [Terri.Jordan-Sellers@usace.army.mil](mailto:Terri.Jordan-Sellers@usace.army.mil).

Sincerely,



Eric P. Summa  
Chief, Environmental Branch



**UNITED STATES DEPARTMENT OF COMMERCE**  
**National Oceanic and Atmospheric Administration**  
NATIONAL MARINE FISHERIES SERVICE

Southeast Regional Office  
263 13<sup>th</sup> Avenue South  
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(727) 824-5317; FAX (727) 824-5300  
<http://sero.nmfs.noaa.gov/>

June 3, 2011

Mr. Eric Summa  
Planning Division  
Department of the Army Corps of Engineers  
PO Box 4970  
Jacksonville, Florida 32232

Dear Mr. Summa:

In response to a request from the Jacksonville District, and in partial fulfillment of our agreement to serve as a cooperating agency in the preparation of the Environmental Impact Statement (EIS) for the Port Everglades Expansion Project, we have prepared a report, *Characterization of Essential Fish Habitat in the Port Everglades Expansion Area*. The District may reference this information the EIS and Essential Fish Habitat (EFH) assessment to describe the habitats that would be affected by this project. While the report by itself does not constitute an EFH assessment, it contains several of the mandatory and other components described at 50 CFR 600.920(e)(2).

This report has been peer reviewed by several NOAA scientists and resource managers, including staff from the NOAA Restoration Center in St. Petersburg, Florida; NMFS Protected Resources Division in Ft. Lauderdale, Florida; and NBOAA Coral Reef Conservation Program in Silver Spring, Maryland; and the NOAA Center for Coastal Fisheries and Habitat Research in Beaufort, North Carolina. Records of all technical and editorial comments received are available should they be needed and the final report reflects all change requested. Most importantly, all reviewers concluded the information contained in the report accurately describes the habitats in the Port Everglades area.

Thank you for the opportunity to provide the report. Related correspondence should be directed to the attention of Ms. Jocelyn Karazsia at our West Palm Beach office, which is co-located with the US Environmental Protection Agency at USEPA, 400 North Congress Avenue, Suite 120, West Palm Beach, Florida, 33401. She may be reached by telephone at (561) 616-8880, extension 207, or by e-mail at [Jocelyn.Karazsia@noaa.gov](mailto:Jocelyn.Karazsia@noaa.gov).

Sincerely,

/ for

Miles M. Croom  
Assistant Regional Administrator  
Habitat Conservation Division



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## **Characterization of Essential Fish Habitats in the Port Everglades Expansion Area**

This report was prepared by:  
Jocelyn Karazsia and Pace Wilber, Ph.D.  
NOAA National Marine Fisheries Service  
Southeast Region, Habitat Conservation Division

June 3, 2011

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## List of Acronyms

EFH	Essential Fish Habitat
HAPC	Habitat Area of Particular Concern
SAFMC	South Atlantic Fishery Management Council
FDEP	Florida Department of Environmental Protection
DCC	Dania Cut-off Canal
AIWW	Atlantic Intracoastal Waterway
IEC	Inner Entrance Channel
OEC	Outer Entrance Channel
SAC	South Access Channel
MTB	Main Turning Basin
FMP	Fishery Management Plan
EIS	Environmental Impact Statement

## 1. Essential Fish Habitat Overview

The 1996 amendments to the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) require regional fishery management councils and federal agencies to promote protection, conservation, and enhancement of essential fish habitat (EFH). The EFH provisions of the Magnuson-Stevens Act support one of the Nation's overall marine resource management goals - maintaining sustainable fisheries. Achieving this goal requires maintenance of the quality and quantity of habitats necessary for fishery resources.

The Magnuson-Stevens Act defines EFH as "...those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." Rules promulgated by the National Marine Fisheries Service (NMFS) in 2002 further clarify EFH with the following definitions: **waters** - aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; **substrate** - sediment, hardbottom, structures underlying the waters, and associated biological communities; **necessary** - the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and **spawning, breeding, feeding, or growth to maturity** - stages representing a species' full life cycle. EFH may be a subset of all areas occupied by a species. Acknowledging that the amount of information available for EFH determinations will vary for the different life stages of each species, the rule directs the fishery management councils and NMFS to use the best available information, to take a risk averse approach to designations, and to be increasingly specific and narrow in the delineations of EFH as more refined information becomes available.

The rule also provides for fishery management councils and NMFS to consider more limited designations for each species. Habitat Areas of Particular Concern (HAPCs) are subsets of EFH that are rare, particularly susceptible to human-induced degradation, especially important ecologically, or located in an environmentally stressed area. In general, HAPCs include habitats important for the migration, spawning, and rearing of fish or shellfish. Actions with potential adverse impacts to HAPCs are more carefully scrutinized and subject to more stringent conservation recommendations.

The South Atlantic Fishery Management Council (SAFMC) designates mangrove; seagrass; hardbottom, coral, and coral reefs; intertidal flats; coastal inlets; and other bottom habitats within the Port Everglades project area as EFH (SAFMC 1998). In addition, the Mid-Atlantic Fishery Management Council designates coastal inlets as EFH for bluefish and the NMFS designates coastal inlets as EFH for a variety of sharks.

Within southeast Florida, including the Port Everglades project area, nearshore bottom, coral, coral reef, live/hardbottom, mangroves, seagrass, and coastal inlets are HAPCs (SAFMC 1998). Managed species that commonly inhabit the study area include pink shrimp (*Farfantepenaeus duorarum*); spiny lobster (*Panulirus argus*); and members of the 73-species snapper-grouper complex, including bluestriped grunt (*Haemulon sciurus*), French grunt (*H. flavolineatum*), mahogany snapper (*Lutjanus mahogoni*), yellowtail snapper (*Ocyurus chysurus*), and red grouper (*Epinephelus morio*). These species use inshore habitats as juveniles and sub-adults, and offshore hardbottom and reef communities offshore as adults. Other species of the snapper-grouper complex commonly seen offshore in the study area include gray triggerfish (*Balistes capricus*) and hogfish (*Lachnolaimus maximus*). Coastal migratory pelagic species also commonly utilize the offshore area adjacent to the study area, including cero (*Scomberomorus regalis*) and Spanish mackerel (*S. maculatus*). As many as 60 coral species can occur off the coast of Florida (SAFMC 2009) and these resources fall under the protection of the SAFMC coral, coral reefs, and live/hardbottom Fishery Management Plan (FMP).

Table 1: Federally managed species, categorized by FMP, and species habitat affinity in the Port Everglades project area

Fishery Management Plan (FMP)	Federally Managed Species Known to Occur in Pt Everglades		EFH within the Pt Everglades Expansion Areas	HAPC within the Pt Everglades Expansion Areas
Snapper-grouper FMP	Grunts (all 11 species)	Snappers (8 of 14 species)	Outer Entrance Channel	
	Black margate ( <i>Anistotremus surinamensis</i> ) <sup>2,3</sup>	Juvenile snappers ( <i>Lutjanus</i> spp.) <sup>1</sup>	live/hardbottom and coral reefs	medium to high profile hardbottoms
	Porkfish ( <i>Anisotremus virginicus</i> ) <sup>2</sup>	Mutton snapper ( <i>Lutjanus analis</i> ) <sup>2</sup>	attached macroalgae	nearshore hardbottom areas
	Grunts ( <i>Haemulon</i> spp.) <sup>1</sup>	Schoolmaster ( <i>Lutjanus apodus</i> ) <sup>3</sup>	unconsolidated bottom (soft sediments)	all hermatypic coral habitats and reefs
	Margate ( <i>Haemulon album</i> ) <sup>3</sup>	Gray snapper ( <i>Lutjanus griseus</i> ) <sup>2</sup>		
	Tomtate ( <i>Haemulon aurolineatum</i> ) <sup>3</sup>	Dog snapper ( <i>Lutjanus jocu</i> ) <sup>3</sup>	Interior Areas of Port Everglades	
	Smallmouth grunt ( <i>Haemulon chrysargyreum</i> ) <sup>3</sup>	Mahogany snapper ( <i>Lutjanus mahogoni</i> ) <sup>3</sup>	submerged aquatic vegetation (SAV; seagrass and macroalgae)	mangrove habitat
	French grunt ( <i>Haemulon flavolineatum</i> )	Lane snapper ( <i>Lutjanus synagris</i> ) <sup>3</sup>	tidal creeks	seagrass habitat
	White grunt ( <i>Haemulon plumieri</i> ) <sup>1</sup>	Yellowtail snapper ( <i>Ocyurus chrysurus</i> )	estuarine scrub/shrub (mangrove fringe)	coastal inlet
	Bluestriped grunt ( <i>Haemulon sciurus</i> ) <sup>1</sup>	Groupers and Sea basses (12 of 21 species)	unconsolidated bottom (soft sediments)	
	Sailor's choice ( <i>Haemulon parra</i> ) <sup>3</sup>	Rock hind ( <i>Epinephelus adscensionis</i> ) <sup>3</sup>		
	Cottonwick ( <i>Haemulon melanurum</i> ) <sup>2</sup>	Red grouper ( <i>Epinephelus morio</i> )		
	Spanish grunt ( <i>Haemulon macrostomum</i> ) <sup>2</sup>	Red hind ( <i>Epinephelus guttatus</i> ) <sup>3</sup>		
	Porgies (5 of 9 species)	Coney ( <i>Cephalopholis fulva</i> ) <sup>2</sup>		
	Porgy ( <i>Calamus spp.</i> ) <sup>2</sup>	Graysby ( <i>Cephalopholis cruentata</i> ) <sup>2</sup>		
	Jolthead porgy ( <i>Calamus bajonado</i> ) <sup>3</sup>	Bank sea bass ( <i>Centropristis ocyurus</i> ) <sup>3</sup>		
	Knobbed porgy ( <i>Calamus nodosus</i> ) <sup>3</sup>	Black grouper ( <i>Mycteroperca bonaci</i> ) <sup>3</sup>		
Sources of information:	Littlehead porgy ( <i>Calamus proridens</i> ) <sup>3</sup>	Gag ( <i>Mycteroperca microlepis</i> ) <sup>3</sup>		
<sup>1</sup> DCA 2001	Saucereye porgy ( <i>Calamus calamus</i> ) <sup>3</sup>	Scamp ( <i>Mycteroperca phenax</i> ) <sup>3</sup>		
<sup>2</sup> DCA 2006	Sheepshead porgy ( <i>Calamus penna</i> ) <sup>3</sup>	Yellowfin grouper ( <i>Mycteroperca venenosa</i> ) <sup>3</sup>		
no subscript indicates reported in both both DCA 2001 & 2006	Jacks (5 of 8 species)	Yellowmouth grouper ( <i>Mycteroperca interstitialis</i> ) <sup>3</sup>		
	Blue runner ( <i>Caranx crysos</i> ) <sup>2</sup>	Tilefishes (1 of 3 species)		
	Bar jack ( <i>Caranx ruber</i> )	Sand tilefish ( <i>Malacanthus plumieri</i> ) <sup>2</sup>		
<sup>3</sup> Not reported in DCA 2001 or DCA 2006, but reported in Ferro et al. 2005	Horse-eye Jack ( <i>Caranx latus</i> ) <sup>3</sup>	Triggerfishes (3 of 3 species)		
	Yellow jack ( <i>Caranx bartholomaei</i> ) <sup>3</sup>	Gray triggerfish ( <i>Balistes caprisus</i> )		
	Almaco jack ( <i>Seriola rivoliana</i> ) <sup>3</sup>	Queen triggerfish ( <i>Balistes vetula</i> ) <sup>2</sup>		
	Wrasses (2 of 2 species)	Ocean triggerfish ( <i>Canthidermis sufflamen</i> ) <sup>3</sup>		
	Puddingwife ( <i>Halichoeres radiatus</i> ) <sup>2</sup>	Spadefishes (1 of 1 species)		
	Hogfish ( <i>Lachnolaimus maximus</i> ) <sup>1</sup>	Spadefish ( <i>Chaetodipterus faber</i> ) <sup>2</sup>		
Shrimp FMP (Penaeid)	None observed but since commercial fisheries exists to the north and south of the inlet, the persence of pink shrimp ( <i>Farfantepenaeus duorarum</i> ) is likely. DCA 2001 states that pink shrimp commonly inhabit the study area.		Outer Entrance Channel	
			offshore marine habitats used for spawning and growth to maturity [sand bottom]	
			Interior Areas of Port Everglades	
			subtidal and intertidal non-vegetated flats all interconnected water bodies [to connect areas with appropriate sediment types]	coastal inlet
			mangroves	
			marine and estuarine sav (e.g., seagrass)	
Spiny lobster	None observed, but highly likely. DCA 2001 states that <i>Panularis argus</i> commonly inhabit the study area.		Outer Entrance Channel	
			coral and live/hardbottom habitat	coral/hardbottom habitat from Jupiter Inlet through the Dry Tortugas
			shallow subtidal bottom	
			sponges	
			unconsolidated bottom (soft sediments)	
			Interior Areas of Port Everglades	
			seagrass	
			algal communities ( <i>Laurencia</i> spp.)	
			mangrove habitats (prop roots)	
Coastal Migratory Pelagics	Spanish mackerel ( <i>Scomberomorus maculatus</i> ) <sup>1</sup>		Outer Entrance Channel	
	Cero ( <i>Scomberomous regalis</i> ) <sup>2</sup>		high profile rocky bottom	nearshore hardbottom south of Cape Canaveral
	Cobia ( <i>Rachycentron canadum</i> ) <sup>3</sup>		barrier island ocean-side waters from the surf break to the shelf break	<i>Phragmatopoma</i> worm reefs
			Interior Areas of Port Everglades	
			seagrass	

Table 1 cont'd:

Fishery Management Plan (FMP)	Federally Managed Species Known to Occur in Pt Everglades		EFH within the Pt Everglades Expansion Areas	HAPC within the Pt Everglades Expansion Areas
Coral, Coral Reefs, Live/Hardbottom Habitat	<i>Acropora cervicornis</i> <sup>1</sup>	<i>Mycetophyllia ferox</i> <sup>2</sup>	Outer Entrance Channel	
	<i>Agaricia agaricites</i> <sup>2</sup>	<i>Mycetophyllia lamarckiana</i> <sup>2</sup>	rough, hard, exposed, stable substrate from Palm Beach County south through the Florida Reef Tract in 30 m depth	nearshore (0-4 m, 0-12 ft) hardbottom
Sources of information:	<i>Agaricia lamarcki</i> <sup>2</sup>	<i>Phyllangia americana</i> <sup>2</sup>	for ahermatypic corals hard substrate in subtidal to outer shelf depths	offshore (5-30 m, 15-90 ft) hardbottom from Palm Beach to Fowey Rocks
<sup>1</sup> DCA 2001	<i>Colpophyllia natans</i> <sup>2</sup>	<i>Porites astreoides</i> <sup>2</sup>	EFH for Antipatharia includes rough, hard, exposed, stable substrate offshore in high (30-35‰) salinity waters in depths exceeding 18 m (54 ft)	<i>Phragmatopoma</i> worm reefs
<sup>2</sup> DCA 2006	<i>Dichocoenia stokesii</i> <sup>2</sup>	<i>Porites porites</i> <sup>2</sup>	EFH for octocorals (excludes the Order Pennatulacea) includes rough, hard, stable substrate in subtidal to outer shelf depths	
<sup>3</sup> FDEP 2008	<i>Diploria clivosa</i> <sup>3</sup>	<i>Scolymia</i> spp. <sup>2</sup>		
	<i>Diploria labyrinthiformis</i> <sup>2</sup>	<i>Briareum</i> <sup>2</sup>		
	<i>Diploria strigosa</i> <sup>2</sup>	<i>Ellisella</i> <sup>2</sup>		
	<i>Eusmilia fastigiata</i> <sup>2</sup>	<i>Erythropodium</i> <sup>2</sup>		
	<i>Leptoseris cucullata</i> <sup>2</sup>	<i>Eunicea</i> <sup>2</sup>		
	<i>Madracis decactis</i> <sup>2</sup>	<i>Iciligorgia</i> <sup>2</sup>		
	<i>Madracis pharensis</i> <sup>3</sup>	<i>Muricea</i> <sup>2</sup>		
	<i>Manicina areolata</i> <sup>2</sup>	<i>Muriceopsis</i> <sup>2</sup>		
	<i>Meandrina meandrites</i> <sup>2</sup>	<i>Plexaura</i> <sup>2</sup>		
	<i>Montastraea annularis</i> <sup>2</sup>	<i>Plexaurella</i> <sup>2</sup>		
	<i>Montastraea cavernosa</i> <sup>2</sup>	<i>Pseudoplexaura</i> <sup>2</sup>		
	<i>Mussa angulosa</i> <sup>2</sup>	<i>Pseudopterogorgia</i> <sup>2</sup>		
	<i>Mycetophyllia aliciae</i> <sup>2</sup>	<i>Pterogorgia</i> <sup>2</sup>		
Highly Migratory Species FMP	Finetooth shark ( <i>Carcharhinus isodon</i> ) <sup>1</sup>		Outer Entrance Channel	
	Lemon shark ( <i>Negaprion brevirostris</i> ) <sup>1, 2</sup>		lemon and nurse sharks have habitat affinity for coral reefs	
<sup>1</sup> Wiley & Simpfendorfer 2007	Tiger shark ( <i>Galeocerdo cuvier</i> ) <sup>1</sup>		Interior Areas of Port Everglades	
<sup>2</sup> Snelson & Williams 1981	Atlantic sharpnose shark ( <i>Rhizoprionodon terraenovae</i> ) <sup>1</sup>		tiger and Atlantic sharpnose sharks have affinity for seagrass habitats	
<sup>3</sup> Ferro et al. 2005	Nurse shark ( <i>Ginglymostoma cirratum</i> ) <sup>1, 2, 3</sup>		nurse and lemon sharks have affinity for mangrove habitat	
	Bonnethead ( <i>Sphyrna tiburo</i> ) <sup>1, 2</sup>		tiger, finetooth, and Atlantic sharpnose sharks have affinity for soft bottom habitats	

While not part of the currently proposed action, the Port is considering additional work that may impact two of the seagrass assessment areas (see Figure 1, areas 6 and 7) and six of the seven mangrove assessment areas (see Figure 3). The Council on Environmental Quality (1997) directs that descriptions of baseline conditions in the Affected Environment Section of the Environmental Impact Statement (EIS) provide the necessary context for evaluating cumulative effects in other sections of the EIS. Based on this guidance, mangrove and seagrass assessment areas that are not part of the currently proposed action are included in this appendix of the EIS. This approach recognizes the mobility of fishery resources within nearby habitat types and among different habitat types.

## 2. Seagrass

### ***2.1 Review of literature, related information, and views of recognized experts on the habitat or species that may be affected***

#### ***2.1.1 Community composition of seagrass in the Port Everglades area***

Since 1999, the seagrass community in the Port Everglades area has included *Halophila decipiens*, *H. johnsonii*, and *Halodule wrightii*. The seagrass habitats are spatially and temporally dynamic, but persistently present within each of the seven assessment areas (Figure 1; Table 3). Regardless of species composition or developmental stage, seagrass patches and entire beds can move, the rate of which may vary on scales of weeks to decades (SAFMC 2009). The expansion and contraction of seagrass beds, also referred to as “pulsating patches” may be a long-term survival strategy of *H. johnsonii* (Virnstein et al. 2009) and other seagrass species. For impact assessment purposes, it is important to consider the broader seagrass habitat and not just the currently vegetated portions. Seagrass habitats include not only continuous vegetated beds, but also patchy environments with unvegetated areas between the patches as part of the habitat (SAFMC 2009). Available data show that patchy habitats provide ecological functions similar to continuous meadows (Murphey and Fonseca 1995). The absence of seagrass in a particular location during an isolated survey event does not necessarily mean that the location is not viable seagrass habitat and could be considered as potential habitat if the environmental conditions are suitable. It could indicate present conditions are unfavorable for growth at that moment in time, and the duration of this condition could vary from months to years (SAFMC 2009).

Virnstein et al. (2006) observed seagrass coverage expansion within a year and concluded that seagrass responds rapidly to changing environmental conditions. Because seagrass coverage and density in the Port Everglades area are dynamic, this may also indicate high resilience to changing environmental conditions. However, the consequences of human development and other anthropogenic pressures in a coastal basin and the loss of natural hydrologic buffers can compromise an estuary’s resilience to rapidly recover from natural pressures, e.g., hurricanes and seasonal salinity fluctuations (Steward et al. 2006).

#### ***Halophila decipiens***

*Halophila decipiens* is the only seagrass species identified in all seven assessment areas during survey events. *Halophila decipiens* is also the only seagrass species that has been observed in assessment areas 1 (Outer Entrance Channel, OEC) and 3 (Inner Entrance Channel, IEC) (Figure 1). This species is highly fecund and cosmopolitan, occupying niches that larger-sized perennial species cannot utilize (Hammerstrom and Kenworthy 2003). The short life history of *H. decipiens* and the apparent existence of a buried, but moveable seed bank indicates that spatial organization of this community is dictated first by large-scale dispersal of plant propagules (to hundreds of meters) and then, within a growing season, through physical perturbation, bioturbation, and clonal organization of the seagrass operating over very small distances (Fonseca et al. 2007). This species can contribute to a more clumped distribution early in the growing season with subsequent vegetative extension. Fonseca et al. (2008) point out that large-scale disturbance events, such as hurricanes, act to redistribute *H. decipiens* propagules, whereupon clonal

organization of the plants in their spring to fall existence likely dictates the pattern of seafloor occupation. Furthermore, bioturbation plays an important role in either burying seeds or bringing seeds to the sediment surface where they can germinate. They further note that this species appears to have the facility for resiliency of natural disturbances (e.g., hurricanes) of its community that appear to be able to move the seed bank hundreds, if not thousands, of meters, leading to tremendous seasonal changes in the spatial distribution of the plants. The small seed size and the burial of unvegetated substrate by sediments, coupled with movement along with sediment is a plausible mechanism to explain the inter-annual patterns of seagrass distribution (*sensu* Josselyn et al. 1986). Thus, the definition of “seagrass habitat” for *Halophila* can be highly misleading if presently vacant spaces among patches are not properly considered as requisite space for persistence of the community (*sensu* Fonseca et al. 1998).

Although *H. decipiens* is small and present only through a few months of the year, the species provides significant sediment stabilization (Fonseca 1989). Despite a small size and a relatively low rate of production, *H. decipiens* makes an important contribution to primary production in an ecosystem (Iverson and Bittaker 1986). It is important to note that *H. decipiens* communities are a mosaic of seasonally ephemeral seagrass patches that provide the valuable ecological functions recognized for the larger seagrasses (Hammerstrom et al. 2006), therefore the patchy abundance of *Halophila* is a function of the genus dynamics and should be recognized as the ambient condition (Jud Kenworthy, PhD., personal communication, NOAA National Centers for Coastal and Ocean Science, 2010). Rapid growth, high turnover rates, and labile tissues make *Halophila* spp. a good source of nutrition for several marine herbivores and detritivores (Kenworthy et al. 1989).

#### *Halodule wrightii*

*Halodule wrightii* occurred in four of the seven seagrass assessment areas including areas 2, 5, 6, and 7. It was not observed in any of the seagrass assessment areas in 2006 (DCA 2006), however it was observed in the middle and southern reaches of the Port Everglades area during 2008 and 2009, primarily in assessment areas 5, 6, and 7. *Halodule wrightii* is a highly productive seagrass under a variety of light, nutrient, and salinity conditions and because of this it is known to have ubiquitous distribution and an opportunistic strategy as a colonizing species (Dunton 1996). This species can persist under diminishing environmental conditions by reclamation of nutrients and stored reserves from senescing shoots and rhizomes (Onuf 1996). Rhizome growth and branch rate for *H. wrightii* is high compared to climax seagrass species (e.g., *Thalassia testudinum*) which allows the species to rapidly occupy the space it colonizes, however it has a high shoot mortality and low life expectancy which implies it may not occupy the space over a long period of time (Gallegos et al. 1994).

Heidelbaugh (1999) conducted a study within a 372 m<sup>2</sup> (0.09 acres) study area that examined benthic fauna associated with seagrass and unvegetated bottoms and collected 117 species and 690 macrofaunal organisms from *H. wrightii* beds. The most abundant infaunal organisms belonged to the phylum Nematoda while the most abundant epifaunal species were amphipods and tanaids. The majority of macrofaunal organisms consisted of decapod crustaceans (*Callinectes sapidus*), fishes (*Eucinostomus* sp.), and some gastropods (especially *Bursatella leachii*). An additional study compared nekton densities among *H. engelmannii*, *H. wrightii*, and nonvegetated habitats and, similar to the results of the Heidelbaugh (1999) study, found higher densities in the seagrass habitats (King and Sheridan 2006). These studies and others (Sheridan and Livingston 1983; Stoner 1983; Lewis 1984) conclude that on a per plant biomass basis, *Halodule* provides as much fish and infaunal habitat value as other species with higher above-ground biomass, such as *Thalassia testudinum*.

### *Halophila johnsonii*

Under the Endangered Species Act, the Jacksonville District will separately consult with NMFS on potential effects to threatened *H. johnsonii* from the proposed action, however it is important to note that Johnson's seagrass, like other seagrass species, is also designated as EFH.

*Halophila johnsonii* was documented by at least one survey in all assessment areas except the OEC and IEC. In 2006, *H. johnsonii* was not observed in two assessment areas where it was previously observed (areas 5 and 6), however it returned to these areas in 2009 (Figure 2). The expansion and contraction of *H. johnsonii*, also referred to as "pulsating patches", may be a long-term survival strategy (Virstein et al. 2009). The persistent presence of high density, elevated patches of *H. johnsonii* on flood tidal deltas near inlets suggests that it is capable of sediment stabilization (NMFS 2007). Given the similarities between the morphology of other *Halophila* spp. and *H. johnsonii*, it is reasonable to assume that *H. johnsonii* has the same capabilities as these other species to provide important ecological functions and services to the coastal ecosystem of southeastern Florida (NMFS 2007).

In the Heidelbaugh study (1999), *H. johnsonii* beds yielded a total of 126 species (69 epifauna and 57 infauna). Three hundred and twenty macrofaunal organisms were collected from *H. johnsonii* beds. NMFS has concluded that the conservation of *H. johnsonii* will not only maintain the diversity of the seagrass communities, but also the important biodiversity and biophysical characteristics of the entire ecosystem (NMFS 2007).

#### 2.1.2 Ecological functions of seagrass and seagrass as EFH

The SAFMC designated seagrass as EFH for species managed under the snapper-grouper, spiny lobster, and coastal migratory pelagics FMPs. See Table 1 for a list of species associated with seagrass habitats and documented in the project area. Gray snapper (*Lutjanus griseus*) was observed in both reef fish surveys (DCA 2001; DCA 2006). Other studies from Florida have reported that young gray snapper are frequently captured in shrimp trawls in seagrass beds at night (Serafy et al. 2007). Other species managed under the snapper-grouper FMP that show an affinity for seagrass habitat include juvenile dog snapper (*L. jocu*), goliath grouper (*Epinephelus itajara*), bluestriped grunt, spiny lobster, and pink shrimp. Additionally, species managed under the highly migratory species FMP, such as tiger (*Galeocerdo cuvier*) and Atlantic sharpnose (*Rhizoprionodon terraenovae*) sharks have an affinity for seagrass habitats.

Many ecological functions are associated with seagrass, including nutrient recycling, detrital production and export, sediment stabilization, and provision of food and habitat for many life stages of numerous marine species. The most well-known function of seagrass is the role as habitat for numerous fishes and invertebrates. Some species spend their entire lives within seagrass beds and others utilize them only during certain stages of their life cycles (usually the postlarval and juvenile stages). Seagrass beds are one of the primary nursery habitats for coastal marine fauna because of their abundance of prey items as well as the protection they provide from predators. Like many of the larger species, *Halophila* species provide organic matter, habitat structure, and food for benthic feeding organisms (Valentine and Heck 1999). In addition, *Halophila*-based ecosystems provide important food for herbivorous reptiles (Ross 1985).

Seagrass habitats perform numerous important functions in coastal ecosystems that aid in successful spawning, feeding, and growth of several seasonal and resident fishery species, thus serving as EFH. SAFMC (2009) provides a review of several studies which have concluded that, although juvenile fish and shellfish can use other types of habitat, many estuarine species rely on seagrass for either part of their life history or some aspect of their nutrition, and that the loss or reduction of this habitat will produce concomitant declines in juvenile fish settlement. Seagrass habitat type is essential to many species of commercial, recreational and ecologically important shellfish and finfish (SAFMC 2009). *Halophila*-

based ecosystems, as occur in the Port Everglades project area, are particularly important habitats for penaeid shrimp (Ross 1985). Scientific evidence also indicates other species have a strong reliance on seagrass habitats, including blue crabs and spiny lobster (SAFMC 2009).

One of the more important functions of seagrass as EFH is the nursery role. Seagrass habitats serve as nurseries for juvenile fish and their food sources. Seagrass habitats also affect ecological processes which enable fish to grow and mature to different ontogenetic stages, eventually reaching adult forms and emigrating to other habitats (Orth et al. 1984; Koenig and Coleman 1998). Several studies indicate that juvenile fishes are the most abundant age group in seagrass beds, especially in more temperate waters (SAFMC 2009). In particular, juvenile yellowtail snapper and French grunt are highly associated with seagrass beds (Cocheret de la Moriniere et al. 2002). Seagrass functions as a nursery is critical for many estuarine dependent fishery species in the South Atlantic region such as gag (*Mycteroperca microlepis*), flounders (family Pleuronectidae), red drum (*Sciaenops ocellatus*), weakfish (*Cynoscion regalis*), and striped mullet (*Mugil cephalus*) (Thayer et al. 1984).

The same ecological characteristics of seagrass beds that make the habitat favorable for juveniles similarly benefit larval fish and invertebrates. There have been a few studies dealing with larval fish settlement and use of seagrass habitats. Parish (1989) documented that seagrass provides habitat for settling postlarvae and developing juvenile reef fishes. Seagrass beds are important for the brooding of eggs (for example, Atlantic silverstripe halfbeak, *Hyporhamphus unifasciatus*) and for fishes with demersal eggs (e.g., rough silverside, *Membras martinica*). Larvae of spring-summer spawners such as anchovies (*Anchoa* spp.), gobies, (*Gobiosoma* spp.), northern pipefish (*Syngnathus fuscus*), weakfish, southern kingfish (*Menticirrhus americanus*), red drum, silver perch (*Bairdiella chrysoura*), rough silverside, feather blenny (*Hypsoblennius hentz*), and halfbeaks are present and use seagrass beds (SAFMC 2009).

A large proportion of the seasonal residents of seagrass habitats in the South Atlantic region spawn offshore on continental shelves and reefs, enter the estuaries in late winter and early spring and take up residency until fall or until they reach a certain ontogenetic stage when they move to other habitats or offshore to renew this cycle. The proximity of seagrass to the Port Everglades Inlet may increase the value of the seagrass habitats located near the inlet, in particular for oceanic and estuarine spawners. Gilmore (1995) concluded that estuarine-ocean inlet seagrass meadow fish faunas are ontogenetically coupled with rich nearby ocean reef fish communities and support the richest estuarine ichthyofauna (214 species from seagrasses, 282 from ocean inlets). In addition, ocean inlet seagrass meadows are preferred habitat for mutton snapper juveniles (*Lutjanus analis*) (Gilmore 1995). Red drum, speckled trout (*Cynoscion nebulosus*), and weakfish spawn near inlet systems in late summer and fall and use seagrass as nursery areas (Street et al. 2005). In addition to seasonal and migratory species, there are resident fish species and other fauna that continuously utilize seagrass beds (Sogard et al. 1987).

In addition, seagrass habitats transfer unique biological, physical and chemical characteristics to water bodies which both directly and indirectly contribute to the necessary attributes of EFH (Zieman 1982; Thayer et al. 1984). Seagrass habitats play an important role as EFH by influencing the environment they grow in as well as adjacent environments. Essentially, seagrass habitat affects water flow, velocity, and turbulence, thereby creating an environment favorable to settlement of fish and fish food. Organic and inorganic particles settle into the seagrass beds providing nutrients and food, enriching the environment and enhancing secondary production. In turn, the substrate is stabilized, nutrients are temporarily conserved within the meadows and water quality is improved by the presence of seagrass. These ecological services enhance the environmental conditions favoring high rates of primary and secondary production in support of healthy and abundant fish communities (SAFMC 2009).

## 2.2 Review of available seagrass surveys

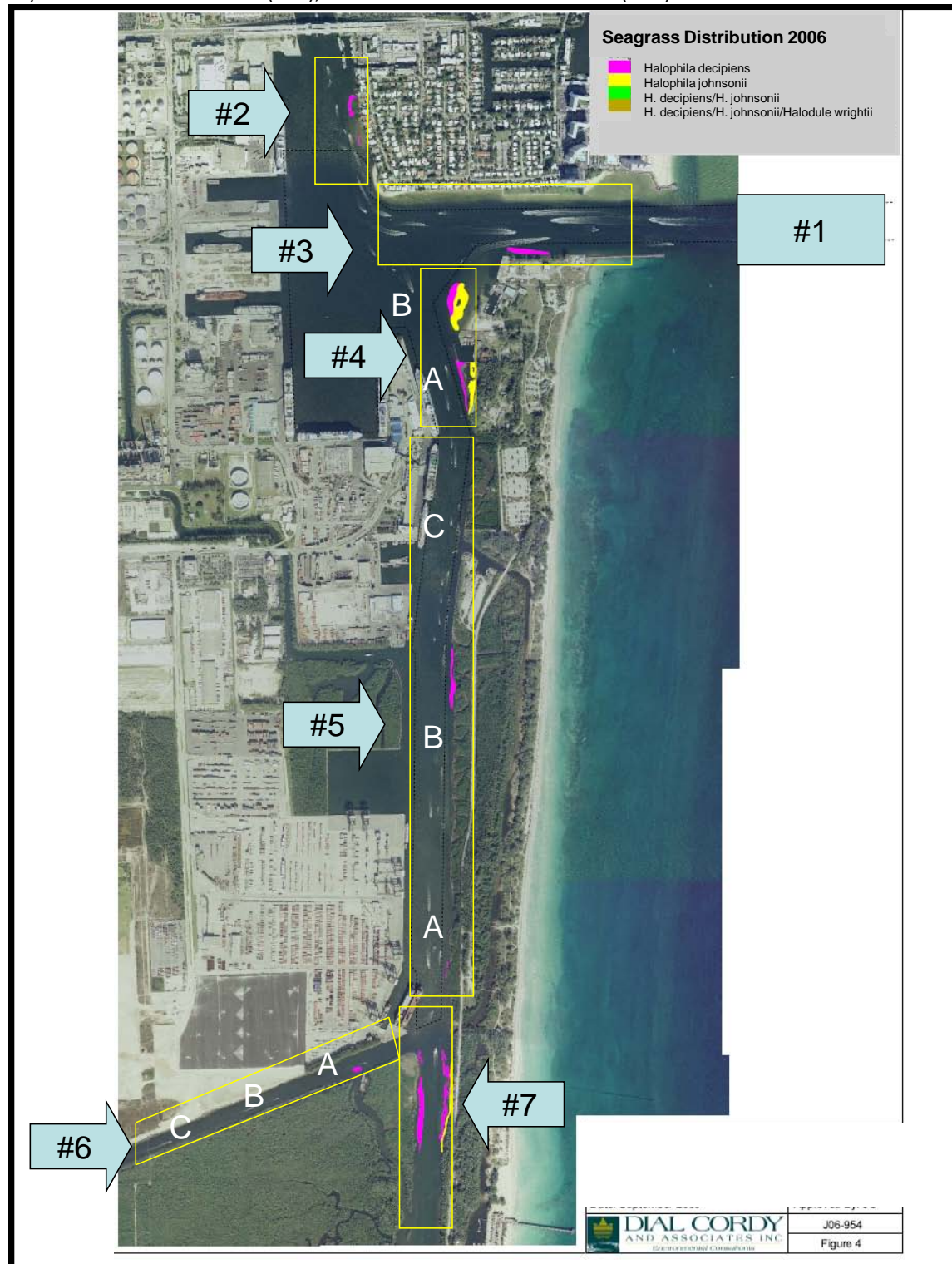
NMFS characterized seven seagrass assessment areas that were defined based on similarities in water depth, water quality and clarity, and landscape position (Figure 1). A summary of each assessment area is provided below and is based on six seagrass mapping, surveying, or verification efforts conducted in Port Everglades between 1999 and 2009 (Table 2).

Table 2: Seagrass surveys performed in the Port Everglades Area between 2001 to 2009

Study reference	Date of Study	Spatial Scope of Survey
DCA 2001	1999 to 2001	Expansion area (except Outer Entrance Channel) and surrounding areas
DCA 2001	2001	Outer Entrance Channel
DCA 2006	2006	Areas where seagrass was observed in DCA 2001
FDEP 2008	2008	Project area, except Outer Entrance Channel and portions of the South Access Channel
Miller Legg 2009	2008 to 2009	Dania Cut-off Canal
DCA 2009	2009	Expansion area, except Outer Entrance Channel

DCA (2001), based on a survey performed from 1999 to 2001, documented 8.71 acres of seagrass within the study area. This survey report includes results from an integrated video assessment conducted in May 2001 that identified *Halophila decipiens* in the OEC. DCA (2006), based on a survey performed in 2006, documented 8.44 acres of seagrass within the study area. The Florida Department of Environmental Protection (FDEP, 2008) provided seagrass polygon and point data from an interagency verification survey in the Port Everglades Area during June 2008. This verification survey was completed by representatives of FDEP, NMFS, Broward County, Jacksonville District, Florida Fish and Wildlife Conservation Commission (FWC), and Fish and Wildlife Service. The purpose of the verification survey was to define specific seagrass assessment areas for the purposes of completing a Uniform Mitigation Assessment Method, to verify the results of previous surveys, and to determine if seagrass had expanded into new areas. In August 2008 and August 2009, additional surveys were completed along the Dania Cut-Off Canal (DCC) portion of the project area associated with a separate project at West Lake Park (Miller Legg 2009). In 2009, 11.98 acres of seagrass were documented in the project area (DCA 2009). In 2009, NMFS and FWC completed an additional verification survey in the DCC. Table 3 provides the acreage of seagrass within each assessment area for each survey in addition to the cumulative acreage for the assessment area over multiple survey years.

Figure 1 : Seagrass assessment areas (modified from figure 4 in DCA 2006). Note area 1 is the Outer Entrance Channel (OEC); area 3 is the Inner Entrance Channel (IEC); area 5 is within the Atlantic Intracoastal Waterway (AIWW) or South Access Channel (SAC); area 6 is the Dania Cut-off Canal (DCC)



#### *Seagrass Assessment Area 1:*

This area is located within the Outer Entrance Channel and supports 1.04 acres of *H. decipiens* (DCA 2001). This area has not been re-surveyed since 2001. Therefore, the 2001 acreage is used as the cumulative acreage of this area.

#### *Seagrass Assessment Area 2:*

This is the northernmost seagrass area within the proposed Port expansion area and is north of the IEC and main turning basin (MTB) and along the eastern side of the Atlantic Intracoastal Waterway (AIWW). In 1999, this area contained 1.54 acres of mixed *H. decipiens*, *H. johnsonii*, and *Halodule wrightii* (DCA 2001). In 2006, the area contained 0.63 acres of *H. decipiens* (DCA 2006). The 2008 interagency verification survey of this area did not reveal any notable changes in seagrass distribution, however a mixed *H. decipiens* and *H. johnsonii* bed along the east slope of the AIWW was observed. In 2009, the area contained 0.13 acres of *H. johnsonii*, a decrease in acreage and a notable shift from a mixed seagrass community to a monospecific bed. The cumulative coverage is 2.07 acres (Table 3).

Table 3: Cumulative seagrass area by assessment site.

Seagrass Assessment Area	2001 Acres	2006 Acres	2009 Acres	Cumulative Acres
1	1.04	Not surveyed	Not surveyed	1.04
2	1.54	0.63	0.13	2.07
3	0.68	0.58	0.09	0.75
4	1.26	3.89	3.87	5.51
5	0.84	0.55	0.05	1.15
6	0.24	0.12	0.74	1.01
7	4.11	2.67	7.11	7.92
<b>Total</b>	<b>9.70</b>	<b>8.44</b>	<b>11.98</b>	<b>19.45</b>

#### *Seagrass Assessment Area 3:*

This area is located within the IEC and the MTB. In 2001, *H. decipiens* was documented along the northern side of the IEC (DCA 2001) and in 2001 and 2006 *H. decipiens* was documented along the southern side of the IEC (DCA 2001; DCA 2006). In 2008, additional *H. decipiens* was observed along the entire northern side of the IEC and along the south side of the IEC. Although the seagrass bed along the southern side of the IEC extended to the east, additional points were not collected (FDEP 2008). In 2009, *H. decipiens* was documented along the northern and southern sides of the IEC (DCA 2009). In 2001, the seagrass acreage in this area was 0.68 acres and in 2006 the seagrass acreage was 0.58 acres. In 2009 the seagrass acreage in this area was 0.09 acres. The cumulative acreage is 0.75 acres (Table 3).

#### *Seagrass Assessment Area 4:*

This area is located south of the IEC. In 2001 this area contained 1.26 acres of monospecific *H. johnsonii* (DCA 2001) and in 2006 this area contained 3.89 acres of *H. johnsonii* and *H. decipiens* (DCA 2006). This area was not verified in 2008. In 2009, the area contained 3.87 acres of mixed *H. decipiens* and *H. johnsonii* (DCA 2009). The cumulative acreage is 5.51 acres (Table 3).

#### *Seagrass Assessment Area 5:*

This area is located along the southern access channel (SAC). In 2001, the area contained 0.84 acres of *H. johnsonii*, *H. decipiens*, and *Halodule wrightii* (DCA 2001). In 2006, this area contained 0.55 acres of *H. decipiens* (DCA 2006). In 2009, the area contained 0.05 acres of *H. johnsonii*, *H. decipiens*, and *Halodule wrightii*. The 2006 report documents a complete species transition (from *H. wrightii* to *Halophila decipiens*) within one bed along the SAC (see Figure 2). In preparation for the interagency

verification survey in 2008, the area was subdivided into three assessment areas, identified as areas A, B, and C (see Figure 1). The 2008 verification survey did not include Area C. However, the 2008 survey documented a notable increase in seagrass locations along Areas A and B. In 2009, this bed transitioned again to a mixed *H. wrightii*, *Halophila decipiens*, and *H. johnsonii* bed (DCA 2009). The cumulative seagrass acreage is 1.15 acres (Table 3).

#### *Seagrass Assessment Area 6:*

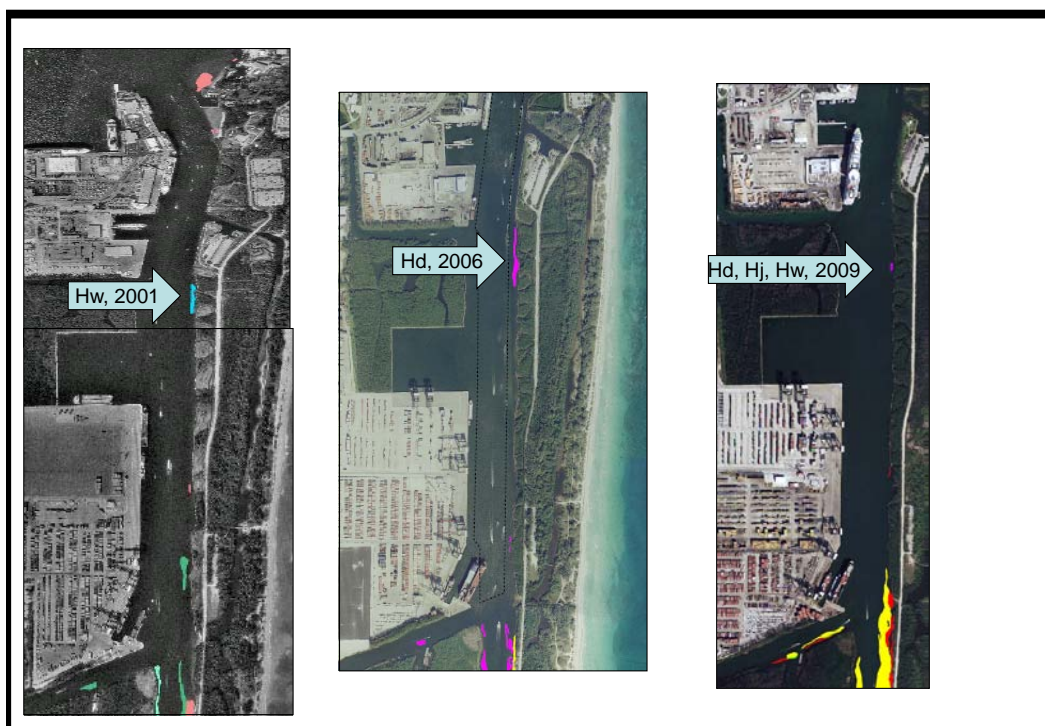
This area is not within the current footprint of the proposed project. In 2001, the area contained 0.24 acres of *H. decipiens*, *H. johnsonii*, and *Halodule wrightii* along the southern side of the DCC. In 2006 the area contained 0.12 acres of monospecific *H. decipiens* along the south side of the DCC. The 2008 verification survey documented a notable increase in seagrass locations along the north and south sides of the DCC. Of particular importance is the documentation of a westward expansion of the *Halophila* species and the expansion of seagrass habitat to the north side of the DCC, in addition to one observation of *Halodule wrightii*. In 2009, *H. johnsonii* and *H. decipiens* were documented along the south side of the channel and *H. johnsonii* along the north side of the channel. In 2009, 0.74 acres of seagrass were documented in this area. The cumulative acreage in this area is 1.01 acres (Table 3).

In 2009, the survey geographic scope did not include transects in the entire western seagrass expansion area (DCA 2009). On July 31, 2009, NMFS and FWC attempted to conduct a seagrass survey west of the Port Everglades project area associated with the review of a separate project proposed by the Florida Inland Navigation District. However, biologists were unable to complete the survey because the bottom was covered in cyanobacteria. NMFS swam along the Port Everglades project survey area (on the south side of the DCC) and observed similar conditions. Cyanobacteria blooms are common in this area and appear to correlate with periods of warm water, freshwater inputs, and increased nutrient inputs from upstream of the DCC (Ryan St. George, personal communication, Broward County Department of Environmental Protection and Growth Management, 2009).

#### *Seagrass Assessment Area 7:*

Similar to assessment area 6, this area is not within the current footprint of the proposed project. This area is located along the AIWW south of the DCC. This was the only area where seagrass was documented along the western side of the AIWW. In 2001 the area contained 4.11 acres of mixed *H. johnsonii*, *H. decipiens*, and *Halodule wrightii*, however *Halodule wrightii* was only observed along the east side of the AIWW. In 2006, the area contained 2.67 acres of *H. johnsonii* and *H. decipiens*. Based on the 2008 verification survey, it did not appear that conditions have changed much in this area, except for the channel-ward migration of a *H. johnsonii* bed along the east side of AIWW. In 2009, the area contained 7.11 acres of *H. johnsonii*, *H. decipiens*, and *Halodule wrightii*. Similar to 2001, the *Halodule wrightii* was only observed along the east side of the AIWW. Another notable change is that the west side of the AIWW only contained *H. decipiens* and in all previous years, *H. johnsonii* was also observed along the west side of the AIWW. The cumulative seagrass acreage is 7.92 acres (Table 3).

Figure 2: 2001 to 2009 species transition along SAC From left to right, DCA 2001 (Figures 8-9), and DCA 2006 (Figure 4), and DCA 2009 (Figure 5). Hw = *Halodule wrightii*; Hd = *Halophila decipiens*; Hj = *H. johnsonii*



### 2.3 Cumulative seagrass area assessment from 2001 to 2009

A GIS was used to examine the changes in seagrass coverage between 2001, 2006, and 2009. NMFS determined that the 2001 report documented 9.70 acres<sup>1</sup> of seagrass; the 2006 report documented 8.44 acres of seagrass; and the 2009 report documented 11.98 acres of seagrass. The latter two reports did not survey the OEC. Based on this analysis, the cumulative seagrass coverage in the Port Everglades area is 19.45 acres (Table 3).

## 3. Mangroves

### 3.1 Review of literature, related information, and views of recognized experts on the habitat or species that may be affected

Mangrove habitats are ecologically important coastal ecosystems (Lugo and Snedaker 1974). Mangrove wetlands in the Port Everglades project area provide a buffer against storm surges, reduce shoreline erosion and turbidity, absorb and transform nutrients, and are inhabited by a variety of organisms, including various life stages of federally managed fishes. Mangrove habitats provide shelter for larval, juvenile and adult fish and invertebrates, in addition to contributing dissolved and particulate organic

<sup>1</sup> We note that the acreage listed in the 2001 report does not include the OEC seagrass bed and the acreage provided for two polygons exceeds the square feet, resulting in a net difference of 0.047 acres.

detritus to estuarine food webs. Because of this linkage, both as habitat and as food resources, mangroves are important exporters of material to coastal systems as well as to terrestrial systems. Mangroves help shape local geomorphic processes and are important in the heterogeneity of landforms which provide shelter, foraging grounds and nursery areas for terrestrial organisms. The root system binds sediments thereby reducing sedimentation to nearby habitats and contributing to sediment stabilization. Mangrove communities support mobile components, most of which, from a fisheries standpoint, interact with the community during flood tides (Gilmore and Snedaker 1993). Transient representatives typically are represented by larval and juvenile stages of both invertebrates and fish commonly found using the fringe and overwash island mangrove forests, and frequently the adult stage is found in adjacent seagrass meadows or in reef structures.

Mangrove habitats provide nursery habitat, feeding and growth, and refuge for both recreationally and commercially important fishery organisms and their food resources when flooded. It has long been recognized that mangrove habitats in the southeastern U. S. are important to fishery resources (Odum 1988; Gilmore and Snedaker 1993). Mangroves are important for the growth and development of many marine fishes and there is a high dependence of juveniles on mangroves as nursery areas (Baelde 1990; Rooker and Dennis 1991; Nagelkerken et al. 2000; Mumby et al. 2004).

Worldwide, mangrove ecosystems have declined by approximately 35 percent (Valiela et al. 2001). In Florida, where most U.S. mangroves are located, current mangrove coverage represents a significant reduction from coverage that existed 100 years ago (Gilmore and Snedaker 1993). Specifically, in southeast Florida (Monroe to Martin counties) mangrove acreage declined 11% from 1987 to 2000 (Ueland 2005). Nearshore mangrove habitats along the southern Florida coast also contribute substantially to regional reef fish resources, which also supports a tourist industry and recreational and commercial fisheries valued in billions of dollars (Bohnsack and Ault 1996). Mangrove habitats directly benefit the fishery resources of estuaries and coral reefs within and adjacent to Port Everglades and the Atlantic Ocean by providing nursery habitat. The cumulative loss of these habitats continues to reduce fisheries production within Florida waters.

### 3.1.1 Ecological function of mangroves and mangroves as EFH

The SAFMC designated mangroves as EFH-HAPC for species managed under the snapper-grouper FMP. Federally managed species documented in the Port Everglades expansion area and associated with mangrove habitat include bluestriped and French grunts; and gray and mutton snappers. Other snapper-grouper species known to utilize mangrove habitat include goliath grouper. Additionally, species managed under the highly migratory species FMP, such as nurse (*Ginglymostoma cirratum*) and lemon (*Negaprion brevirostris*) sharks exhibit an affinity for mangrove habitats. See Table 1 for a list of species associated with mangrove habitat and documented in the project area.

A few studies have quantified fishes within mangroves of southeast Florida. In a study located south of Port Everglades, Thayer et al. (1997) found 36 species exclusively in mangroves, 24 species in adjacent seagrass, 27 species in both habitats, thereby yielding a total of 63 species for mangroves in study sites that ranged in area from 21.7 to 58.2 m<sup>2</sup> (233.6 to 626.5 ft<sup>2</sup>). In a study within the Indian River Lagoon, located north of Port Everglades, Gilmore (1995) sampled estuarine mangroves over a period of more than 20 years, and recorded 88 species of fish. Spiny lobsters and pink shrimp are the most important commercial and recreational invertebrates commonly found among the prop roots of red mangroves (*Rhizophora mangle*). However, important links in the trophic structure, i.e., the amphipods, isopods, polychaetes, etc., are also prominent invertebrate components of the mangrove prop-root habitat. Snook (*Centropomus undecimalis*), goliath grouper, tripletail (*Lobotes surinamensis*), leatherjack (*Oligoplites saurus*), gray snapper, dog snapper, sailor's choice (*Haemulon parra*), bluestriped grunt, sheepshead (*Archosargus probatocephalus*), black drum (*Pogonias cromis*) and red drum also are common to this habitat, using it as refuge and as a ready source of food (SAFMC 2009). Recent studies have documented

that juvenile goliath grouper exhibit high site fidelity for mangroves and that mangrove habitats clearly fulfill an important nursery function for this species (Koenig et al. 2007; Frias-Torres 2006).

In particular, studies from southeast Florida highlight the importance of mangrove habitat for gray snapper (Luo et al. 2009) which have been documented in fish surveys conducted for Port Everglades expansion planning (DCA 2001; DCA 2006). For all life stages, mangroves are daytime resting areas for fish, thereby providing protection from predation (Luo et al. 2009). Mangroves are generally vacated at night as individuals forage in adjacent seagrass beds (Rooker and Dennis 1991; Nagelkerken et al. 2000). After foraging, gray snappers return to and shelter in resting schools in complex habitats such as mangrove prop roots (Rooker and Dennis 1991). Luo et al. (2009) also observed high densities of large (>25 cm), mature fishes, suggesting that mangrove habitats also serve as staging areas for adult congregation prior to seasonal spawning migrations to offshore reefs (Sheridan and Hays 2003).

Mangrove tidal creeks and ditches, similar to the habitat located in assessment area 2 (Figures 3 and 4), are not well-studied (Gilmore and Snedaker 1993), but based on the limited data are also utilized extensively by fishery organisms (Valentine-Rose et al. 2007; Krebs et al. 2007). Large aquatic predators appear to enter this mangrove community through the tidal tributary habitat. In particular, tarpon (*Megalops atlanticus*) is found in mangrove creek habitat. Because this habitat type (at least the creek edges) is flooded most of the time, this can serve as habitat for both resident and transient species. Predaceous fishes common to this mangrove habitat are juvenile bull sharks (*Carcharhinus leucas*), Atlantic stingray (*Dasyatis sabina*), ladyfish (*Elops saurus*), snook, goliath grouper, gray snapper and red drum. Turtles, crocodiles, and alligators also forage in these habitats (SAFMC 2009).

The mangrove basin habitat, similar to the habitat located within the westernmost edge of the Turning Notch (Figure 3, area 1), generally supports a less complete community and may be subject to higher environmental stresses due to seasonal changes in water and thus availability for fishery resources. The more abundant fishes found in this habitat type are cyprinodontiform species such as eastern mosquitofish (*Gambusia holbrooki*) and sailfin molly (*Poecilia latipinna*). These species do provide food resources for surrounding habitats during periods of flooding when there is exchange with the adjoining estuary or riverine system (SAFMC 2009).

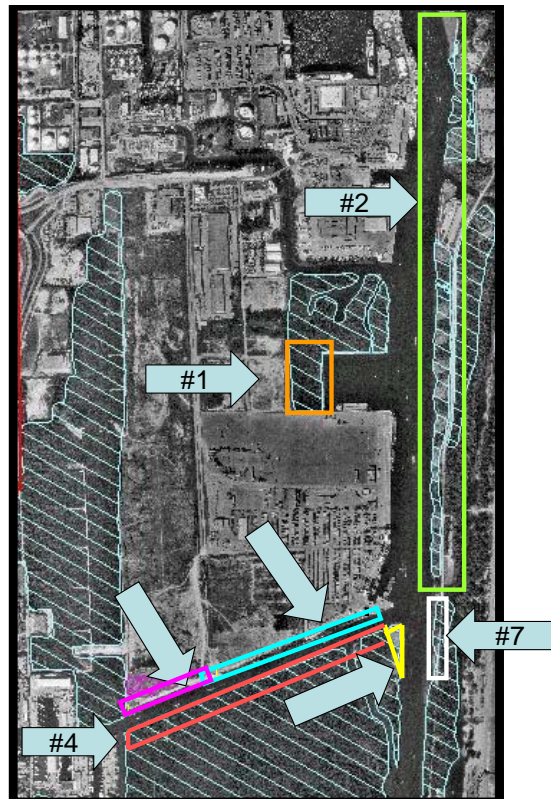
The prevailing paradigm regarding food webs of mangrove-dominated estuarine ecosystems is that they are based on particulate mangrove detritus, but research indicates that the dissolved organic form may be equally important (SAFMC 2009). Each habitat type may export organic matter that generates chemical cues regulating the presence or absence and abundance of estuarine organisms and thus, the predictable spatial and temporal patterns of marine life. For example, Huijbers et al. (2008) showed how post-larval French grunts prefer mangrove waters over coral reef waters. Determining the types and numbers of organisms that exploit these habitats, the functional aspects of habitat use, and how mangrove organic matter is transferred to higher trophic levels is critical, and are requisites for modeling linkages between variations in mangrove productivity and variations in faunal abundances. Mangroves may influence nutrient dynamics and associated coastal productivity by either removing or contributing nutrients to these systems, and data on their function in maintaining water quality of estuarine ecosystems are limited (SAFMC 2009).

### **3.2 Review of available surveys**

NMFS characterized seven mangrove assessment areas that were defined based on similarities in water depth, water quality and clarity, and landscape position (Figure 3). A summary of each assessment area is provided below and is based on information provided in DCA 2001 and one interagency field inspection on May 6, 2008. Field notes from an interagency Estuarine Wetlands Rapid Assessment Procedure conducted in 2001 are also summarized in relevant sections. DCA (2001) characterized five

mangrove areas in the Port Everglades area, generally referred to in Figure 3 as assessment areas 1, 2, 3, 4, and 7. In 2008, NMFS observed mangroves along the northern side of the DCC (identified in Figure 3 as assessment areas 5 and 6).

Figure 3: Mangrove Assessment Areas (modified from DCA 2001). Hatching indicates mangrove habitat and numbered arrows point to assessment areas identified by colored polygon.



No dredging is currently proposed by the Jacksonville District in assessment areas 1, 3, 4, 5, 6, and 7; however the Port may request separate authorizations to dredge these areas. Therefore the assessment areas are included; this approach is consistent with the Council on Environmental Quality's recommendations for describing the affected environment (CEQ 1997). In addition, this information has relevant context because the federally managed fish move among these habitats and adjacent habitats.

#### *Mangrove Assessment Area 1 (also referred to as the Turning Notch)*

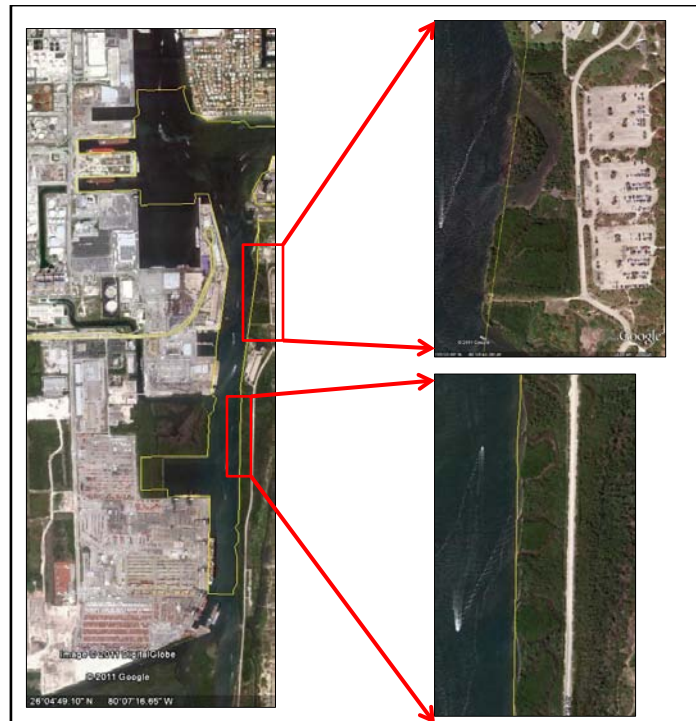
This 8.7-acre area is known as the Turning Notch mangrove assessment area. Fish and Wildlife Service field notes from the Estuarine Wetland Rapid Assessment Procedure (FWS 2001) noted mature and "pure" red black (*Avicennia germinans*), and white (*Laguncularia racemosa*) mangroves in this area. This mangrove area is mitigation for previous wetland impacts associated with the Turning Notch Project (DCA 2001). During the interagency site visit in May 2008, it was noted this area contains a mature mangrove community and the riprap revetment between the mangroves and open water appears to provide sufficient spacing to allow for detrital exchange and fishery resource access.

#### *Mangrove Assessment Area 2*

This area is the only mangrove habitat area contained within the current expansion area. This area contains narrow fringes of mangroves, well-developed mangrove wetlands, a mixed mangrove tidal creek, and oxbow features. The area is located within John U. Lloyd State Park and south of the U.S. Coast

Guard station along the east side of the AIWW (Figure 3). The northern portion of this assessment area was visited on May 6, 2008, during an interagency field inspection that characterized this area as beach sand with a narrow fringe of mangrove (approximately one tree deep). The southern portion of this mangrove area contains a well-developed mangrove wetland with tidal creeks and oxbows (Figure 4). Some of the mangrove habitat in this assessment area is mitigation for previous wetland impacts associated with the Turning Notch Project in the mid-1990s (DCA 2001). Approximately 23 acres of mangroves were planted along the eastern edge of the AIWW at John U. Lloyd State Park for mitigation associated with the Turning Notch Project, however they were not placed under a conservation easement, as they were on state owned land (DCA 2001).

Figure 4: Mangrove and Tidal Creek Habitat Within and Adjacent to Port Everglades Expansion Area. The yellow line indicates limit of proposed dredging.



#### *Mangrove Assessment Area 3 (also referred to as the Salina Assessment Area)*

This is the easternmost polygon along the south side of the DCC. This area was separated from area 4 because it appears to be functioning more as a salina (or salt flat), than as a mangrove community. NMFS and other agencies assessed this area on May 6, 2008, and characterized this area as a triangular shaped spoil area. It appears to be at a higher elevation than mangroves to the south. The area is surrounded by riprap 1 to 2 m (3 to 6 ft) wide that becomes patchy towards the south along the DCC. Red and black mangroves are present along the shoreline and there are little to no invasive, non-native plant species in this area.

#### *Mangrove Assessment Area 4*

This area is located along the southern side of the DCC and has riprap along the shoreline. This area is characterized as actively eroding (Broward County West Lake Park, Conceptual Master Plan C 2001). This was verified during the field inspection in May 2008. Specifically the frequent large vessel traffic and associated large wakes are thought to contribute to the erosion. This area is characterized as supporting a mature red mangrove community (FWS 2001). This was confirmed by agencies during a

field visit in May 2008. In addition, biologists noted that the red mangroves just beyond the eroded zone seem relatively stable and are tidally influenced.

#### *Mangrove Assessment Area 5*

The only available information for this area is from an interagency field inspection in May 2008. This area is located along northwestward side of DCC. A fence exists between assessment areas 5 and 6. This area is characterized as red, black, and white mangroves and is tidally influenced. Fringes are 3 to 5 m (9 f to 15 ft) wide in some areas; 1 to 2 m (3 to 6 ft) wide in other areas. The shoreline generally contains riprap and the boulders vary in size. This area has some infestation of exotic invasive species, including Australian pine (*Casuarina equisetifolia*) and Brazilian pepper (*Schinus terebinthifolius*).

#### *Mangrove Assessment Area 6*

This area is along northeast side of the DCC and supports black and white mangroves; a few red mangroves are also present – generally along the eastern site of this area. The landward portions of this area are tidally influenced. The shoreline contains riprap and the boulders vary in width and size. This area has some infestation by Australian pine and Brazilian pepper. The area between the bulkhead to the east and a riprap wall is devoid of mangroves. There is also a “fill area” that is devoid of vegetated shoreline resources.

#### *Mangrove Assessment Area 7*

DCA (2001) depicts this area as a “fringing mangrove.” No other habitat characterization is available for this area, however the mangroves appear to be tidally influenced.

### **4. Soft bottom habitats as EFH**

Soft bottom habitat is the area with unconsolidated sediment that lacks vascular plants (i.e., no seagrass is present, but macroalgae may be present). Within the interior portions of Port Everglades, the unconsolidated sediments are usually sand, silty sand, or mud with sandy material occurring more commonly in shallow waters and near the inlet and muddy sediments occurring in deepwater waters and towards the Dania Cutoff Canal. Although soft bottom habitat lacks visible structural features, many microscopic plants occur at the sediment surface and burrowing animals commonly occur below the surface (Peterson and Peterson 1979; Alongi 1990); the dominant taxa of macroinfauna are usually polychaetes, crustaceans, mollusks, and echinoderms. One of the more interesting features of soft bottom communities is that the species within this habitat can significantly structure the habitat through processes, such as bioturbation, enhancing water flow through sediments, and tube building, that affect community as a whole. Similarly, soft bottom habitat provides important ecological services to coastal ecosystems (Peterson and Lubchenco 1997). For example, soft bottom areas serve as a storage reservoir of chemicals and microbes. Intense biogeochemical processing and recycling establish a filter to trap and reprocess watershed-derived natural and human-induced nutrients and toxic substances.

One of the more important services provided by soft bottom habitat is foraging habitat for fishery species and their prey. For example, adult white grunts, which are a federally managed fishery species as well as an important food source for species managed within the snapper-grouper complex, are generalized carnivores that feed mainly on benthic invertebrates (Bowman et al. 2000; Potts and Manooch 2001). The high forage value of soft bottom habitat results from the high concentrations of organic matter transported to and produced on soft bottom and the numerically abundant, diverse invertebrate fauna associated with this habitat. While the forage value of soft bottom habitat can vary greatly with position in the landscape, proximity to physical disturbance (such as dredging and wave scour) and chemical disturbances (such as stormwater runoff and low concentrations of dissolved oxygen) can be overriding factors (Pearson and Rosenberg 1978; Diaz and Rosenberg 1995).

Soft bottom habitat also can provide refuge to smaller organisms, such as juvenile fish, because predators are unable to maneuver effectively in shallow waters (Ross and Epperly 1985). Consequently, juvenile fish typically first recruit to the shallowest portions of an estuary or lagoon. Flounder, rays (e.g., *Urobatis jamaicensis* or *Dasyatis americana*), and small cryptic species, such as pink shrimp and blue crabs, can bury in the sediment, camouflaging themselves from predators. Smaller predators in shallow water and larger predators in deeper water also bury themselves in soft bottom habitats relying upon ambush tactics for feeding (Walsh et al. 1999). Consequently, many fish, crabs, and shrimp in subtidal, soft bottom habitats forage nocturnally (Summerson and Peterson 1984).

The high availability of food coupled with the refuge for predators make soft bottom habitats, especially those in shallow waters and those close to mangroves, seagrass, live/hardbottom, or inlets, important nursery areas for many species of juvenile fish. Much of the soft bottom habitat within Port Everglades is near one of these habitats (Figures 1 and 4). Only a few studies have been done of the soft bottom habitat within the interior portion of the port. DCA (2001) summarizes those studies: Rudolph (1986) and Messing and Dodge (1997) identified 370 species of invertebrates within the shallow water benthic community, including polychaetes, oligochaetes, mollusks, sipunculids, peracarid crustaceans, platyhelminthes, and nemertina. While these studies did not sample the deeper areas (i.e., the federal navigation channel or turning basins) it is likely the deeper areas have lower abundances and diversity than the shallower areas. The offshore soft bottom communities located within the study area include polychaete and other worms. In an infaunal study conducted offshore of Hollywood Beach, Dodge et al. (1991) found dominant taxa were polychaetes (52 percent), nematodes (14 percent), and crustaceans (9 percent). Offshore soft bottom habitats within the study area, in particular between the Middle and Outer Reefs, may provide a corridor for reef species to travel between reef lines and also be an important foraging area for some fish species (Jones et al. 1991).

The SAFMC designated soft bottoms as EFH for species managed under the snapper-grouper, shrimp, and spiny lobster FMPs. Federally managed species documented in the Port Everglades expansion area and associated with soft bottom habitat include white grunt, pink shrimp, and spiny lobster. Additionally, species managed by NMFS under the highly migratory species FMP, such as Atlantic sharpnose, bonnethead (*Sphyrna tiburo*), and finetooth (*Carcharhinus isodon*) sharks have an affinity for soft bottom habitats. See Table 1 for a list of species associated with soft bottom habitat and documented in or near the project area.

## 5. Port Everglades Inlet as EFH

Tidal inlets are HAPCs because of the unique role they play as migratory corridors connecting ocean and estuarine waters that serve as spawning and nursery areas for shrimp, red drum, mackerels, and other species (Hettler and Chester 1990; Lindeman et al. 2000; Faunce and Serafy 2007; Serafy et al. 2007). It should be noted that habitats, such as seagrass beds, mangroves, hardbottom, coral, and coral reefs, also are HAPCs, and this close proximity emphasizes this important linkage role for this particular inlet.

Movement of larval and juvenile fish and shrimp through inlets can vary greatly between inlets and over time with some species migrating nocturnally, within portions of the tidal stream, phases of the lunar cycle or interaction of these factors (Forward et al. 1999). The major point being that migration through inlets rarely is a passive process and, instead, reflect behaviors of the migrants. While modeling studies conducted for this project and summarized in this Draft EIS conclude that changes in the physical characteristics of Port Everglades Inlet as a result of dredging will be minor, these studies do not examine the response of fish and other organisms to those changes, and such examinations would be difficult to do. Most larval and juvenile fish that utilize the inlet to access their inshore nurseries respond to a variety

of environmental factors once they reach the inlet (Boehlert and Mundy 1988). Dredging of inlets, including their ebb and flood tide shoals, may result in unanticipated changes to the cues used by migrants to the estuary. Species that orient to cues associated with the sea bottom may be affected by a deepened channel. Channel dredging also may change flow of long-shore currents. These currents not only affect the transport of sediments along the beach but also influence the recruitment of early life history stages of fish and invertebrates into the estuary. In short, complex modeling and empirical studies would be needed to examine how fish would respond to the modified inlet.

The SAFMC designated coastal inlets as EFH for species managed under the snapper-grouper and shrimp FMPs. Additionally, the Mid-Atlantic Fishery Management Council designated coastal inlets as EFH in the bluefish (*Pomatomus saltatrix*) FMP.

## **6. Hardbottoms, coral, and coral reefs**

### ***6.1 Review of literature, related information, and views of recognized experts on the habitat or species that may be affected***

The coral reef system off southeast Florida is a continuation of the Florida Reef Tract and extends approximately 170 km (150 mi) from the border of Biscayne National Park to the south to the St. Lucie Inlet to the north (Collier et al. 2008; Banks et al. 2007; Walker et al. 2008a). The southeast Florida reef system runs parallel to the coast for approximately 500 km (310 mi) from the Dry Tortugas in the south to Martin County in the north. The biological communities living on these high-latitude coral reefs consist of typical Caribbean fauna (Goldberg 1973; Moyer et al. 2003). Offshore Fort Lauderdale, Florida (Broward County) and closest to shore in water depths less than 4 m (12 ft), nearshore hardbottoms are part of a ridge complex and separated in a cross-shore direction by expanses of sand, landward of the coral reefs. Offshore Fort Lauderdale there are generally three lines of coral reef; Inner Reef crests in 3 to 5 m (9 to 15 ft), Middle Reef crests in 7 to 9 m (21 to 27 ft), and Outer Reef crests in 16 to 23 m (48 to 69 ft) water depths (Banks et al. 2007; Walker et al. 2008a). Nearshore of the Inner Reef is a series of nearshore ridges and sand (Moyer et al. 2003; Banks et al. 2007; Walker et al. 2008a).

The coral reef-associated communities in the southeast Florida region are tropical to subtropical in species composition with a fauna and flora similar to the Florida Keys and wider Caribbean. Some faunal differences occur along the Florida Reef Tract in response to water temperature ranges, substrate availability, and other variables (SAFMC 2009), which may affect the abundance of species. A major contributor to coral reef ecosystems is often coral itself, since the corals provide habitat and food for most of the other members of the ecosystem (SAFMC 2009).

The status of coral, coral reef, and live/hardbottom community habitats in southeast Florida have mostly been recorded as part of monitoring efforts (Gilliam et al. 2010; Gilliam 2010) originating as impact and mitigation studies from human activities to specific sites (dredge insults, ship groundings, pipeline and cable deployments, and beach renourishment). Scleractinian coral density is generally 2 to 3 colonies/m<sup>2</sup> and coverage generally 2 to 3%. Much of scleractinian coral cover in this region is less than 1% but several nearshore areas have coverage greater than 10%. The largest known coral colonies in Broward County are large *Montastrea faveolata* colonies ranging from 2 to 4 m in diameter and older than 300 years. These corals are documented on the shallow colonized pavement and nearshore ridges. Coral coverage on these habitats may reach up to 40% or higher in this habitat type (Walker et al. 2008b). Over 30 scleractinian coral species have been identified in southeast Florida with common species including *Montastrea cavernosa*, *Siderastrea siderea*, *Porites astreoides*, and *Stephanocoenia intersepta* (Gilliam et al. 2009). The aforementioned species have also been documented in the Port Everglades expansion area (Tables 1 and 4). Octocorals are generally more abundant than scleractinian corals in this

region. Density can approach 20 colonies/m<sup>2</sup> with coverage of 20% (Gilliam et al. 2010). Much less data exist on the species richness due to the difficulty of field identification, but common species include several *Eunicea* species, *Eunicea flexuosa*, *Pseudopterogorgia americana*, and *Muricea muricata*, all (genera) of which have been documented in the Port Everglades expansion area (Tables 1 and 4). Additionally, southeast Florida (especially offshore Broward County) has a number of unique and extensive staghorn coral, *Acropora cervicornis*, patches. These patches have measured coverages greater than 30% (Gilliam et al. 2010). Under the Endangered Species Act, the Jacksonville District will consult with NMFS on potential effects to threatened elkhorn (*A. palmata*) and staghorn coral from the proposed action, however it is important to note that elkhorn and staghorn coral, like other coral species and the associated hardbottom habitat, are also designated as EFH-HAPC.

The SAFMC designates coral, coral reef, and hardbottom habitats as EFH-HAPC for species managed under the snapper-grouper, spiny lobster, and coral, coral reef, and live/hardbottom FMPs. Additionally, sponge habitats are designated EFH-HAPC for the spiny lobster FMP. All demersal fish species under SAFMC management that associate with coral habitats are contained within the FMP for snapper-grouper species and include some of the more commercially and recreationally valuable fish of the region. All of these species show an association with coral or hardbottom habitat during their life history. In groupers, the demersal life history of almost all *Epinephelus* species, several *Mycteroperca* species, and all *Centropristis* species, takes place in association with coral habitat (SAFMC 2009). Coral, coral reef, and hardbottom habitats benefit fishery resources by providing food or shelter (SAFMC 1983).

Federally managed species with affinity to coral, coral reef, and hardbottom habitat include several species of snappers from the genus *Lutjanus* (including the juvenile gray snapper), yellowtail snapper, gray triggerfish, various species of grunts from the genus *Haemulon*, bar jack (*Caranx ruber*), graysby (*Epinephelus cruentatus*), red grouper, and coney (*Cephalopholis fulva*). All of the aforementioned species were identified in fish surveys completed for Port Everglades expansion planning (see DCA 2001; DCA 2006). Other federally managed species that utilize coral, coral reef, and hardbottom habitat in waters offshore Broward County include scamp (*Mycteroperca phenax*), gag, bank seabass (*Centropristis ocyurus*) and almaco jack (*Seriola rivoliana*). Ferro et al. (2005) documented these species in marine waters offshore Broward County in addition to 204 other species of fish. Additionally, species managed by NMFS under the highly migratory species FMP, such as lemon and nurse sharks have an affinity for coral reef habitats. See Table 1 for a list of species associated with coral, coral reef or live/hardbottom habitat and documented in the project area.

Table 4: Corals documented in Port Everglades Field Studies. Type of scleractinian coral also noted.

Scleractinian				Octocorals
massive	brooder	branching	other	genera
<i>Colpophyllia natans</i>	<i>Agaricia agaricites</i>	<i>Acropora cervicornis</i> <sup>1</sup>	<i>Leptoseris cucullata</i>	<i>Briareum</i>
<i>Dichocoenia stokesii</i>	<i>Agaricia lamarcki</i>	<i>Porites porites</i>	<i>Phyllangia americana</i>	<i>Ellisella</i>
<i>Diploria clivosa</i> <sup>2</sup>	<i>Porites astreoides</i>			<i>Erythropodium</i>
<i>Diploria labyrinthiformis</i>	<i>Siderastrea radians</i>			<i>Eunicea</i>
<i>Diploria strigosa</i>				<i>Iciligorgia</i>
<i>Eusmilia fastigiata</i>				<i>Muricea</i>
<i>Madracis decactis</i> <sup>3</sup>				<i>Muriceopsis</i>
<i>Madracis pharensis</i> <sup>2,3</sup>				<i>Plexaura</i>
<i>Manicina areolata</i>				<i>Plexaurella</i>
<i>Meandrina meandrites</i>				<i>Pseudoplexaura</i>
<i>Montastraea annularis</i>				<i>Pseudopterogorgia</i>
<i>Montastraea cavernosa</i>				<i>Pterogorgia</i>
<i>Mussa angulosa</i>				
<i>Mycetophyllia aliciae</i>				
<i>Mycetophyllia ferox</i>				
<i>Mycetophyllia lamarckiana</i>				
<i>Scolymia</i> spp.				
<i>Siderastrea siderea</i>				
<i>Solenastrea bournoni</i>				
<i>Solenastrea hyades</i>				
<i>Stephanocoenia intersepta</i>				

All species documented in DCA 2006, except:

<sup>1</sup> from DCA 2001

<sup>2</sup> from FDEP 2008

<sup>3</sup> Branch morphology as well

## 6.2 Review of Available Coral Reef Surveys

Five survey reports are available that map and characterize the coral reef and hardbottom habitats within the Port Everglades project area (Table 5). In 2000 and 2001, a towed underwater video approach was used to record hardbottom and coral reef habitats along the Port Everglades project area. Additional video and field data were collected to assess the accuracy of the maps. This effort is described in DCA (2001). Additionally, in February and March 2006, contractors for the Jacksonville District assessed coral reef habitats along the Middle and Outer Reefs within the Port Everglades project area. The findings from this effort are provided in DCA (2006). Additionally, in 2006, representatives from FDEP conducted a separate field inspection of the Outer Reef and portions of the Middle Reef channel wall. In 2007, representatives of FDEP visited portions of the Inner Reef channel wall. Results are reported in FDEP (2007). Finally, as part of a separate project Gilliam and Walker (2008) surveyed the rubble shoal and portions of the channel wall.

Table 5: Coral reef and fish surveys conducted in the Port Everglades area between 2001 and 2008

Study reference	Date	Spatial Scope of Survey
DCA 2001	1999 to 2001	Port Expansion and nearby areas
Ferro et al. 2005	1998 to 2002	Offshore Broward County
DCA 2006	2006	Middle and Outer Reef
FDEP 2007	2006 and 2007	Channel wall, Outer Reef
Gilliam and Walker 2008	2008	Channel wall and rubble shoal

Seven distinct hardbottom and coral reef habitat types are present within the Port Everglades project area. These include the Outer Reef, Middle Reef, Inner Reef, channel wall, nearshore hardbottom, rubble shoal, and submerged breakwater (see Figure 5). Each of these habitat types are described below based on available survey information. The nearshore hardbottom, rubble shoal, and submerged breakwater are grouped together based on how they are described in the available information. Based on the 5 available survey reports, 29 species of scleractinian corals and 12 genera of octocorals have been documented in the Port Everglades expansion area (Table 4). Species listed are representative of the Port Everglades project area, however notably absent from DCA (2006) are octocorals of the genus *Gorgonia* and the barrel sponge *Xestospongia muta*, which are a dominant fauna component of the coral reefs off southeast Florida, including the Middle Reef. Also notably absent in the surveys conducted by DCA (2001 and 2006) are scleractinian corals larger than 50 cm in diameter within the Middle Reef and Outer Reef. Representative photos of a subset of species from field efforts are provided in Figure 6.

#### Outer Reef

Seventeen scleractinian coral species and 12 octocoral genera have been documented in the Outer Reef areas within and adjacent to planned Port expansion (DCA 2006). Overall scleractinian colony density ranged from 1.4 to 2.2 colonies/m<sup>2</sup> and octocoral density ranged from 0.1 to 1.7 colonies/m<sup>2</sup>. At the time of the survey conducted by DCA in 2006, they estimated coral densities and determined that 60,882 scleractinian corals and 47,206 octocorals were located within the direct impact area of the Outer Reef. Barrel sponges were observed in highest densities at Outer Reef sites (0.2 colonies/m<sup>2</sup>). Corals of the Outer Reef were qualitatively described as healthier (compared to the Middle Reef) and less than 3% of the corals showed evidence of poor colony condition, such as paling, bleaching, or partial mortality (DCA 2006).

DCA (2006) grouped corals into 4 size classes I = 0 to 3 cm; II = 4 to 10 cm; III = 11 to 25 cm; IV = 26 to 50 cm (Table 6). At the time of the survey conducted in 2006, DCA estimated that most of the scleractinian corals were in size class II, however they reported corals in all other size classes (Table 6). They did not observe corals greater than 50 cm along the survey transects. However, during a FDEP field inspection on October 18, 2006, biologists observed corals greater than 50 cm in diameter along the Outer Reef within the Outer Entrance Channel seaward extension area (FDEP 2007). Direct impact (dredging) area estimates for the Outer Reef range from 6.9 ac (DCA 2006) to 13.5 ac (Walker et al. 2008b). The amount of Outer Reef within the 150 m indirect impact zone is approximately 28.3 ac (Walker et al. 2008b) (Table 7).

Table 6: Distribution of scleractinian colony size by species, reef, and zone, as encountered in visual belt transects off Port Everglades in March 2006. Sizes were organized in four size classes: Class I = 0 to 3 cm; Class II = 4 to 10 cm; Class III = 11 to 25 cm; Class IV = 26 to 50 cm [R=Reef; Z=Zone; PI=Previously Impacted; C=Control]. From DCA 2006.

	R2-Z1				R2-Z2				R3-Z1				R3-Z2				R3-Z3				R3-PI-Z1				R3-PI-Z2				R3-PI-Z3				R3-C-Z1				R3-C-Z2				R3-C-Z3				
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	
<i>Agaricia agaricites</i>	0	1	0	0	0	0	0	0	1	2	1	0	0	0	1	0	1	5	2	0	1	0	0	0	0	1	0	0	0	2	0	0	0	1	1	0	0	0	4	1	1	3	0	0	
<i>Agaricia fragillis</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
<i>Agaricia humilis</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
<i>Agaricia lamarcki</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
<i>Colpophyllia natans</i>	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	
<i>Dichocoenia stokesii</i>	0	1	0	0	0	0	0	3	1	0	0	5	3	0	0	0	2	0	0	1	1	0	0	1	5	0	0	5	1	0	2	3	0	0	0	0	1	0	2	2	1	0	0		
<i>Diploria labyrinthiformis</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
<i>Diploria strigosa</i>	0	0	2	0	0	0	0	0	0	2	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	
<i>Eusmilia fastigiata</i>	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0
<i>Favia fragum</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
<i>Leptoseris cucullata</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
<i>Madracis decactis</i>	0	0	1	0	0	4	0	0	2	2	1	0	0	4	5	0	2	5	4	0	2	4	2	0	3	6	2	0	3	2	2	0	1	7	0	0	0	2	0	0	1	1	3	0	0
<i>Manicina areolata</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
<i>Meandrina meandrites</i>	0	1	2	0	0	1	1	0	2	3	2	0	2	4	0	0	0	5	2	0	0	2	0	0	1	2	0	0	1	2	0	0	0	2	0	0	0	1	0	0	0	1	1	0	0
<i>Montastrea annularis</i>	2	3	0	0	0	3	4	0	1	1	0	0	0	0	0	0	0	1	4	0	3	1	0	0	0	1	3	1	1	2	5	0	1	1	0	0	0	3	1	0	3	2	1	1	
<i>Montastrea cavernosa</i>	0	4	2	1	1	6	4	0	12	26	16	0	8	13	2	0	11	12	5	0	11	8	2	0	4	12	8	0	8	8	8	1	6	23	8	2	1	6	8	2	6	12	9	1	
<i>Mycetophyllia aliciae</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
<i>Mycetophyllia ferox</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
<i>Porites astreoides</i>	0	3	0	0	0	7	1	0	9	61	13	0	2	18	0	0	1	28	18	2	6	47	8	0	1	13	2	0	2	28	3	0	3	48	5	1	1	15	4	0	6	19	7	0	
<i>Porites porites</i>	0	0	0	0	0	0	0	0	4	1	0	0	1	0	0	1	1	2	0	5	3	0	0	0	2	0	0	0	0	0	0	0	0	6	0	0	2	6	2	0	5	6	1	0	
<i>Scolymia spp.</i>	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
<i>Siderastrea siderea</i>	11	8	2	0	8	10	1	0	44	30	1	0	29	23	5	0	24	38	4	0	44	60	2	0	21	16	1	0	28	25	4	0	8	26	4	0	15	19	3	0	18	21	0	0	
<i>Siderastrea radians</i>	3	3	0	0	2	3	0	0	13	15	1	0	7	10	1	0	4	8	1	0	10	5	0	0	10	5	0	0	5	12	0	0	3	7	0	0	2	3	0	0	3	4	1	0	
<i>Solenastrea bournoni</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1	1	1	0	0	1	1	0	0	
<i>Stephanocoenia intersepta</i>	3	7	0	0	9	15	2	0	34	24	0	0	29	36	3	0	18	38	6	1	30	21	0	0	19	28	1	0	12	34	1	0	10	18	1	1	12	12	2	0	19	32	1	0	

Figure 5. Coral Reef Habitat Types within the Port Everglades Expansion Area (from Walker et al. 2008b)

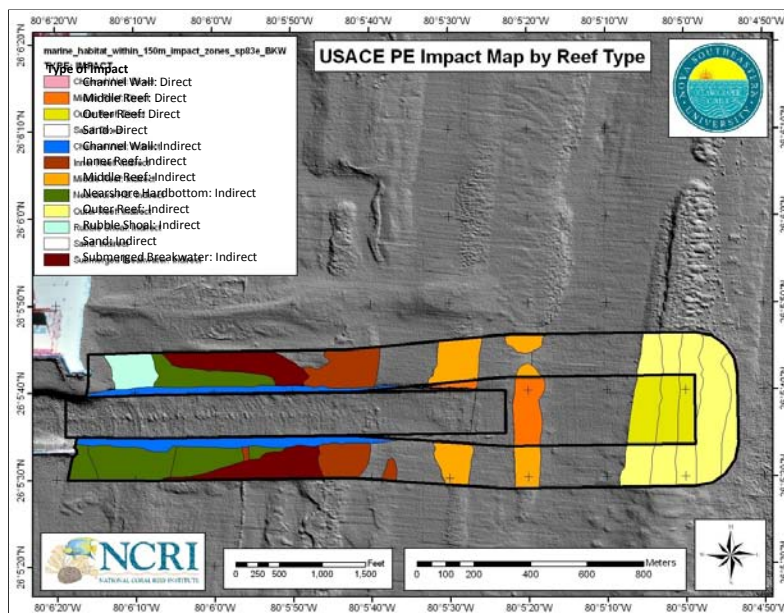


Table 7: Coral Reef Area by Habitat Type (modified from Walker et al. 2008b)

Habitats within dredge area	Type	Modifiers	Area (ft <sup>2</sup> )	Acres (ac)	Type ac
Coral Reef and Colonized Hardbottom	Outer Reef	Aggregated Patch Reef	301	0.01	13.54
		Spur and Groove	154971	3.56	
		Linear Reef-Outer	180259	4.14	
		Colonized Pavement-Deep	254450	5.84	
	Middle Reef	Linear Reef-Middle	296089	6.80	6.80
Inlet Channel Floor	Inlet Channel Floor	Inlet Channel Floor	2341644	28.59	53.76
Soft Bottom	Sand	Sand	1245485	28.59	28.59

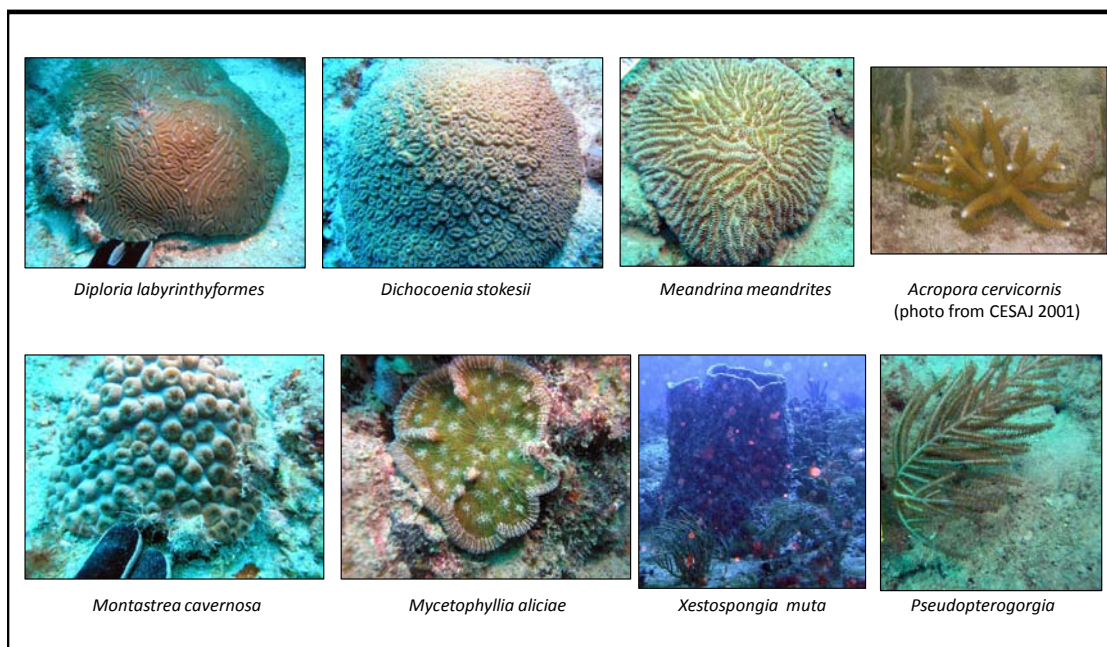
Habitats within 150 m of dredge area

Coral Reef and Colonized Hardbottom	Outer Reef	Ridge-Deep	178647	4.10	28.26
		Aggregated Patch Reef	257808	5.92	
		Spur and Groove	265158	6.09	
		Linear Reef-Outer	245716	5.64	
		Colonized Pavement-Deep	283893	6.52	
	Middle Reef	Linear Reef-Middle	296089	15.98	15.89
	Inner Reef	Linear Reef-Inner	589069	13.52	13.52
	Nearshore Hardbottom	Colonized Pavement-Shallow	639856	14.69	22.67
		Ridge-Shallow	347739	7.98	
Rubble Shoal	Rubble Shoal	Rubble Shoal	208071	4.78	4.78
Submerged Breakwater	Submerged Breakwater	Submerged Breakwater	748786	17.91	17.91
Inlet Channel Wall	Inlet Channel Wall	Inlet Channel Wall	661113	15.18	15.18
Soft Bottom	Sand	Sand	2413861	55.41	55.41

### Middle Reef

Thirteen scleractinian coral species and 9 genera of octocorals have been documented along Middle Reef areas within planned Port expansion (DCA 2006). The overall scleractinian colony density was 0.5 colonies/m<sup>2</sup> and octocoral density ranged from 0.3 to 0.4 colonies/m<sup>2</sup>. At the time of the survey conducted by DCA in 2006, they estimated coral densities and determined 25,546 scleractinian corals and 24,100 octocorals were located within the direct impact area of the Middle Reef. This area of Middle Reef was qualitatively described as having higher sediment cover, however less than 12% of the corals showed evidence of poor colony condition, such as paling, bleaching, or partial mortality. No barrel sponges were observed (DCA 2006). Direct impact (dredging) area estimates for the Middle Reef range from 11.9 ac (DCA 2006) to 6.8 ac (Walker et al. 2008b). The amount of Middle Reef within the 150 m indirect impact zone is approximately 15.9 ac (Walker et al. 2008b) (Table 7).

Figure 6: Representative photos from Port Everglades Field Studies. (Photo credit: Vladimir Kosmynin, PhD. FDEP 2007, except where otherwise noted)



### Channel Wall

Representatives of the FDEP and Broward County visited several sites along the channel wall located along the Middle Reef and Outer Reef on October 18, 2006. Per the FDEP field report, the Middle Reef channel wall is characterized as an artificially created outcrop composed by *Montastraea annularis* framework, which is evidence of middle reef origin. FDEP (2007) states this area is well-flushed with little to no evidence of sedimentation stress. Substrate of wall contains a high diversity of scleractinian coral fauna including *Agaricia agaricities*, *Montastraea cavernosa*, *M. annularis*, *M. faveolata*, *Meandrina meandrites*, *Diploria labyrinthiformis*, *D. strigosa*, *D. clivosa*, *Porites astreoides*, *P. porites*, *Stephanocoenia intersepta*, *Eusmillia fastigiata*, *Dichocoenia stokesii*, *Madracis* spp., *Mycetophyllia*

*ferox*, *Siderastrea siderea*, and the hydrocoral *Millepora alcicornis*. Coral colonies up to 40 cm in diameter were observed. The wall is also dominated by several species of sponges and encrusting calcareous red algae (FDEP 2007). Notably, the species assemblage is similar to the species list in DCA (2006), however FDEP also observed *Diploria clivosa*, which was not recorded in the DCA (2006) (Table 4).

FDEP (2007) refers to portions of the channel wall that transitions from inside the channel to outside the channel as “channel shoulder”. The channel shoulder is characterized as relatively low relief and with fewer species of scleractinian corals, which appear to be of smaller size than on the wall. Scattered octocorals were observed, although octocorals were not observed along the channel wall. Higher levels of sedimentation were observed in this area, which is thought to influence the fauna on the shoulder, especially in lower parts of relief (FDEP 2007).

The western portions of the channel wall from the Inner Reef (to the east) have been mapped and characterized separately. FDEP visited the north wall (further west part of the entrance channel in the area of the Inner Reef) in September 2007. The shoulder was observed to be very similar in character to what is described in the Middle Reef and Outer Reef channel wall section, with scattered colonies of *Dichocoenia stokesii*, *Solenastrea bournoni*, and octocorals. Along the wall overhangs, encrusting colonies of *Madracis* cf. *pharensis* were observed and estimated to be 2 m in diameter. *Madracis pharensis* was not documented in DCA (2006). In addition, Gilliam and Walker (2008) characterized, mapped, and assessed benthic habitats on a portion of the channel wall, located near the Port Entrance (Figure 7). They estimated 1,373 scleractinian corals on the channel wall and shoulder in this area (0.41 acres), with 649 larger than 10 cm in diameter, including one 90 cm diameter *Madracis decatis*. The direct impacts to the channel wall are unclear. The amount of channel wall habitat located within the 150 m indirect impact area is 15.18 ac (Walker et al. 2008b) (Table 7).

#### Inner Reef

While portions of the Inner Reef were surveyed in 2000 and 2001 by DCA, information in the corresponding survey report does not distinguish between reef areas. However the report notes that the area between the Inner Reef and Middle Reef is characterized by small isolated hermatypic coral heads and interspersed coral rubble, with areas of open sand (DCA 2001). Walker et al. (2008b) described the Inner Reef in Broward County as colonized by coral species with mostly flat growth forms (*Diploria clivosa*, *Meandrina meandrites*), octocorals, and algae. No direct impacts to the Inner Reef are currently planned through port expansion activities, however 13.5 acres of Inner Reef is located within 150 m of the planned expansion (Walker et al. 2008b) (Table 7).

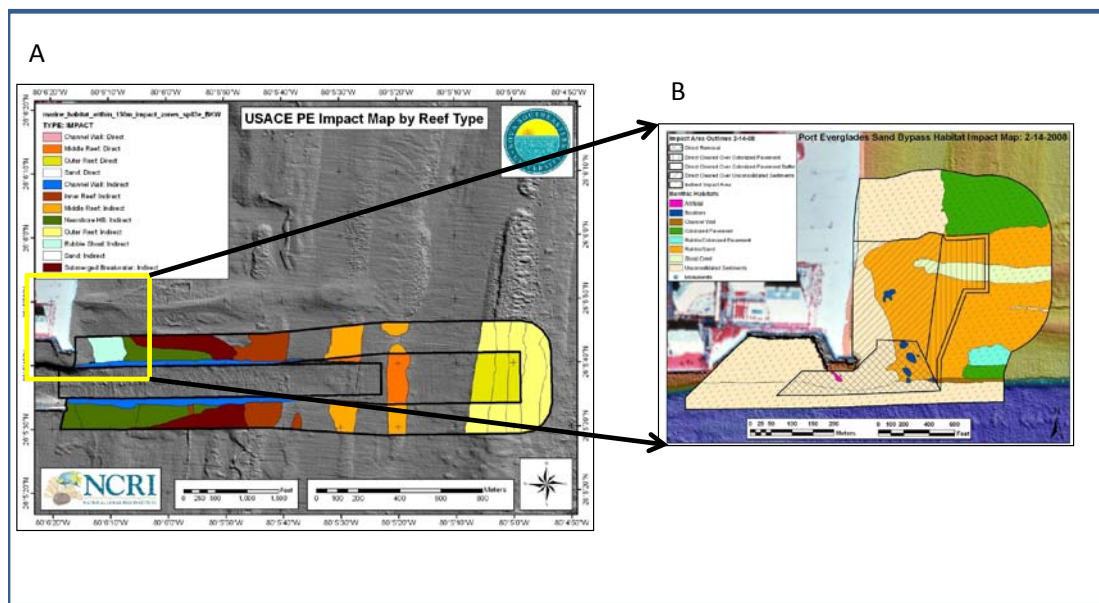
#### Rubble Shoal, Submerged Breakwater, and Nearshore Hardbottom

Gilliam and Walker (2008) characterized, mapped, and assessed benthic habitats on a portion of the area referred to as the “rubble shoal”. There is overlap with the Port Everglades OEC expansion (Figure 7), in particular in areas characterized as sand/rubble (orange), colonized pavement south (green), rubble with colonized pavement (aqua), unconsolidated sediment (beige), and channel wall (brown). The rubble with colonized pavement area is within the Port Everglades injury area, and Gilliam and Walker (2008) estimated 7,698 scleractinian corals within this area (1.06 acres surveyed) with 1,094 corals larger than 10 cm diameter. The largest coral documented was 35 cm (*Solenastrea bournoni*). The colonized pavement south area (0.73 acres surveyed), which is also within this injury area, was estimated to have 3,597 scleractinian corals with 594 corals greater than 10 cm diameter. The largest documented coral was also 35 cm (*S. bournoni*).

In 2001, DCA collected video and field data from nearshore hardbottom habitats located near Port Everglades. DCA characterized the hardbottom areas as exposed rock with a fine covering of sand. The biological communities were characterized as dominated by algae and sponges with interspersed

gorgonians and scleractinian corals. Photos depicted several species of corals located along this nearshore hardbottom, including *Acropora cervicornis* (Figure 6). Approximately 22.7 ac of nearshore hardbottom is located within the 150 m indirect impact area is 4.78 ac and the Submerged Breakwater habitat is 17.19 ac (Walker et al. 2008b) (Table 7).

Figure 7: Overlap of Gilliam and Walker (2008) study area, referred to as “B” with Port Expansion, referred to as “A”



### 6.3 Description of Cumulative Coral Age within the Expansion Area

In determining coral age, corals can first be grouped based on life history functions such as growth rate, reproduction (fecundity, mode of larval dispersal, recruitment success), morphology, the ability to develop coral reef framework, and other factors. For this estimate, scleractinian corals were grouped into one of three major categories including massive, brooders, and branching. This categorization does not work well for some corals, for example the cup coral (*Phyllangia americana*) which was observed in the project area (DCA 2006). However this other category of corals represent less than 0.1% of the total corals documented in the project area, and they can be assessed separately.

Most growth rates (linear extension) for *Montastraea*, *Porites*, and *Diploria* are less than 1 cm/yr (SAFMC 2009). Hubbard and Scaturo (1985) report average extension rates of 0.12 to 0.45 cm/yr for several species [documented in the Port Everglades Expansion area] including *Stephanocoenia intersepta*, *Agaricia agaricites*, *Diploria labyrinthiformis*, *Montastraea cavernosa*, *Porites astreoides*, and *Siderastrea siderea*. Consideration of how old the scleractinian corals are in the Port Everglades expansion area can provide context for describing the affected environment. Coral age within a project area by species and size class, in addition to several other factors, can be fed into a resource equivalency analysis (e.g., Habitat Equivalency Analysis or HEA) to scale a compensatory mitigation requirement. However, this approach does not consider the loss of coral reef framework (see habitat area estimates in

Table 7), which would also need to be a component of any effort to scale the compensatory mitigation requirement associated with Port Everglades expansion.

All coral species documented in DCA (2006) were assigned as branching, brooding, or massive. Quantitative data from DCA (2006) was only available for scleractinian corals from the Middle and Outer Reef areas and this evaluation is limited to these assessment areas. DCA (2006) groups corals into 4 size classes (Table 6). Since actual measured sizes of individual corals are not provided in the report, the mean coral size within each size class was used. For example for size class II, 7 cm is used as the mean coral size. For size class I, 2 cm is used as the mean, since the report states that organisms less than 1 cm were not identified (DCA 2006).

#### Determining Coral Age by Coral Type and Size Class

The sum of all corals within each size class for each group of coral was estimated by multiplying the percentage of each type of coral per size class by the total number of scleractinian corals within the project impact areas. Using coral colony density estimates provided in DCA (2006) (86,248 scleractinian within the project impact areas), which were derived from Table 6, the estimated colonies measuring 7 cm in diameter (size class II) are approximately 31,542 massive corals. Therefore, approximately 36.5% of the corals in the project impact area are massive corals that average 7 cm in diameter (size class II). Known growth rates from published literature for each category of coral (summarized in Tables 8 and 9) were then multiplied by the average size of each size class to obtain the average age of each coral in each size class. For massive corals, 0.560 cm/year is used. Therefore, a size class II massive coral is approximately 12.5 years old. Finally, this age was multiplied by the estimated number of colonies in the impact area to get the total lost age of corals in each size class. For example, for massive corals in size class II, this amounts to 394,275 years.

#### Massive Corals

The massive category includes (but is not limited to) the *Montastrea* complex, the *Diploria* spp., *Solenastrea bournoni*, and *Siderastrea siderea* (see Table 4). These corals are generally broadcast spawners and the main framework builders on Atlantic/Caribbean reefs. In southeast Florida, most species spawn over a few nights clustered around the full moon in later summer. Larval recruitment is rare (Kojis and Quinn 2001) and slow (Clark and Edwards 1999). In areas like southeast Florida with lower coral cover density, a dependency on synchronous spawning may constitute a major life history bottleneck for broadcast spawners (SAFMC 2009). Approximately 72% of the corals documented in DCA (2006) are classified as massive corals. Based on the coral colony density estimates provided, 62,159 corals would be massive corals. Based on a review of the literature, the average growth rate for massive corals is estimated to be 5.60 mm/yr (Table 8). Therefore the cumulative age of massive corals in the Port Everglades expansion area is approximately 757,041 years (Table 10).

Table 8: Literature review of massive coral growth rates conducted by NOAA Restoration Center (Tom Moore and Sean Griffin, NOAA Restoration Center, personal communication, 2011).

Source	Reference	Range (mm/yr)		Average
Edmunds 2007	<i>Diploria</i> spp.	5.3	7	6.15
Vermeij 2006	<i>Diploria</i> spp.	6	6	6
Hubbard & Scaturo 1985	<i>D. labyrinthiformis</i>	3.3	4.6	3.95
Highsmith et al. 1983	<i>M. annularis</i>	6.3	6.3	6.3
Hubbard & Scaturo 1985	<i>M. annularis</i>	2.9	10.2	6.55
Highsmith et. Al., 1983	<i>M. cavernosa</i>	4.3	4.3	4.3
Hubbard & Scaturo 1985	<i>M. cavernosa</i>	2.9	4.5	3.7
Hubbard & Scaturo 1985	<i>Siderastrea siderea</i>	1.5	3	2.25
Edmunds 2007	<i>S. siderea</i>	2.2	5.2	3.7
Bright et al. 1984	<i>M. annularis</i>	5	5	5
Carricart-Ganivet & Merino 2001	<i>M. annularis</i>	6.8	10.03	8.415
Carricart-Ganivet et al. 2000	<i>M. annularis</i>	6	10.54	8.27
Dodge 1981	<i>M. annularis</i>	7.9	10.5	9.2
Foster 1980	<i>M. annularis</i>	5.28	5.28	5.28
Guzman et al. 2001	<i>M. annularis</i>	6.3	10.2	8.25
Hudson 1981	<i>M. annularis</i>	5	11.3	8.15
Leder et al. 1991	<i>M. annularis</i>	5.3	5.3	5.3
Foster 1980	<i>S. siderea</i>	3.9	3.9	3.9
Guzman et al. 2001	<i>S. siderea</i>	3.8	5.7	4.75
Guzman et al. 1994	<i>S. siderea</i>	4.2	4.5	4.35
Ruesink 1997	<i>S. siderea</i>	5.5	5.5	5.5
Stern et al. 1977	<i>S. siderea</i>	4.1	5.4	4.75
Soong & Lang 1992	<i>S. siderea</i>	5	5	5
		4.729565	6.48913	5.609348

### Brooding Corals

The brooder category includes (but is not limited to) the *Agaricia* complex, *Favia fragum*, *Porites astreoides*, and *Siderastrea radians* (Table 4). Recruitment, especially in injured areas, is generally dominated by the brooding species (Miller et al. 2009). Brooding species often release larvae on a lunar cycle over several months or year round (SAFMC 2009). Brooders tend to have a high reproductive output due to the ability to self-fertilize and settle shortly after release. Brooders do not generally attain large colony size and therefore have limited contribution to coral reef framework building (Smantz 1989). Brooders also have a high tolerance to transplantation stress (Gleason et al. 2001).

Approximately 26% of the corals documented in DCA (2006) are classified as brooders. Based on the coral colony density estimates provided in DCA (2006) (86,428 scleractinian corals on the Middle Reef and Outer Reefs within the direct project footprint), 22,340 corals would be brooders. Based on a review of the literature, the average growth rate for brooders is estimated to be 4.88 mm/yr (Table 9). Therefore the cumulative age of brooding corals in the Port Everglades expansion area is approximately 359,565 years (Table 10).

Table 9: Literature review of brooding coral growth rates conducted by NOAA Restoration Center (from Tom Moore and Sean Griffin, NOAA Restoration Center, personal communication, 2011)

Source	Reference	Range (mm/yr)		Average
Edmunds 2007	<i>Siderastrea radians</i>	1.7	4.2	2.95
Bastidas & Garcia 1999	<i>Porites asteroides</i>	2.1	3.5	2.8
Bak & Engel 1979	<i>Agaricia</i> spp.	8	8	8
Gladfelter et al. 1978	<i>P. astreoides</i>	3	3.5	3.25
Gleason et al. 2001	<i>P. astreoides</i>	2.6	3.5	3.05
Guzman et al. 2001	<i>P. astreoides</i>	3.9	6.2	5.05
Guzman et al. 1994	<i>P. astreoides</i>	4.3	4.6	4.45
Highsmith et al. 1983	<i>P. astreoides</i>	2.9	6.9	4.9
Huston 1985	<i>P. astreoides</i>	2.2	4.5	3.35
Rogers et al. 1984	<i>Agaricia</i> spp.	14.4	14.4	14.4
Hughes & Jackson 1985	<i>Agaricia</i> spp.	5.8	5.8	5.8
Vermeij 2006	<i>Agaricia</i> spp.	5	5	5
Vermeij 2006	<i>P. astreoides</i>	3	3	3
Carlson 2001	<i>Agaricia</i> spp.	5	5	5
Edmunds 2007	<i>P. astreoides</i>	3.7	6.1	4.9
Edmunds 2007	<i>Agaricia</i> spp.	2.2	5.2	3.7
Edmunds 2007	<i>Favia fragum</i>	2.1	4.7	3.4
		4.229412	5.535294	4.882353

### Branching Corals

The branching category is limited to *Porites porites*, as other branching corals – e.g., *Acropora cervicornis* and *Dendrogyra cylindrus*, were not documented in the expansion area by DCA.

Approximately 2% of the scleractinian corals documented in DCA (2006) are branching corals. Based on the coral colony density estimates provided, 1,928 corals in the Port Everglades expansion area would be branching corals. Based on a review of the literature, the average growth rate for *P. porites* is estimated to be 14.1 mm/yr (Hubbard and Scaturro 1985), however in the case that other branching corals are documented in the study area (e.g., *Acropora cervicornis*), an adjustment here would need to be made. Therefore the cumulative age of branching corals in the Port Everglades expansion area is approximately 9,603 years (Table 10).

### Other Corals

The other coral category is a catchall for cup corals and other corals such as *Leptoseris cucullata*<sup>2</sup>. Not much is known about growth rates for these species, however these species represent less than 0.1% of the corals in the project area at the time of the DCA survey in 2006. Coral age estimates for this category would have to be determined separately.

### Scleractinian Coral Age Estimates within the Expansion Area

Based on examination of coral age within the expansion area using data from DCA (2006) as a way to describe the affected environment, approximate cumulative age of corals in the expansion area is 1,126,209 years (Table 10).

<sup>2</sup> Also referred to as *Hellioseris cucullata*

Table 10: Summary of coral age estimates by coral type in the Pt Everglades expansion area

Type of coral	Avg growth rate	Estimated #	Coral Age
Massive	5.6 mm/yr	62,159	757,041
Brooding	4.9 mm/yr	22,340	359,565
Branching	14.1 mm/yr	1,928	9,603
<b>Total</b>			<b>1,126,209</b>

#### ***6.4 Scleractinian Impact Scaling Using Size/Species-Frequency Distribution Resource Equivalency Analysis within the Middle and Outer Reef***

In light of their designation as EFH-HAPC's and Executive Order 13089, federal agencies apply greater scrutiny to projects affecting corals, coral reefs, and hardbottoms to ensure practicable measures to avoid and minimize adverse effects to these habitats are fully explored, and in the case that unavoidable impacts are planned, compensatory mitigation is based on the best available approaches and scientific information. There are several approaches which can be used to describe the affected environment and consider the total services that would be lost within the proposed Port Everglades expansion impact areas. One of NOAA's preferred approaches uses a Size/Species Frequency Distribution Resource Equivalency Analysis. As described in Viehman et al. (2009), this modified type of HEA, uses a resource-to-resource method that references the number organisms lost and the number gained through mitigation. In the coral reef environment this approach typically looks at the size-frequency distributions at the species or functional group level to reflect the life history strategies of different corals and allows representation of the (typically non-linear) relationship between services and colony size, thus providing insights into ecological function. Using this approach the metric for scaling becomes a coral colony year (CCY) – which is not equal to the coral age; rather CCY is a proxy for services provided and/or, in the case of any injury, lost during a one year period of time for a particular size and type of coral. While the initial CCY value is only directly comparable to others within the same size/species group equivalency, between sizes and groups can be gained by utilizing a combination of a linear size and service weighting. The key inputs into this analysis are the size/species distribution and the recovery time. The analysis also considers discounting and other important HEA inputs. Importantly, this analysis can help determine if the appropriate coral species and size classes are scalable with respect to the amount and type of compensatory mitigation that is planned.

### **7. Port Everglades Habitat Linkages**

The Port Everglades area is similar to other areas at latitudes that support coral reefs, in that the natural seascape is vegetated primarily by seagrass beds and mangrove wetlands. Within this seascape, many exploited coral reef fishes occupy inshore regions as juveniles before migrating offshore to reproduce thereby undergoing an ontogenetic pattern of habitat utilization. In tropical ecosystems of the Atlantic/Caribbean, coral reefs, mangroves, unvegetated bottom, and seagrass are all physically, chemically and biologically connected. For example, coral reefs dissipate wave energy and promote physical conditions promoting growth of the seagrass and mangroves, both of which filter sediments and protect reefs. As described in the section above, coastal inlets are migratory corridors for fishery resources that utilize oceanic and estuarine habitats. Although not well studied, the biogeography of the Port Everglades area provides for a unique landscape and ecological linkages between coral reef, mangrove, and seagrass habitats in terms of flux of energy and physical occupation of habitats.

Mangrove and seagrass beds are essential habitats for fishes, including species commonly found on reefs. Life history stages that utilize these habitats include the critical early stages (egg, larval, settling, postlarvae, and developing juveniles). Mangrove and seagrass habitats intercept large numbers of larvae and provide abundant food resources and protection from predators (Parrish 1989). These biotopes are also located such a distance from offshore that they are less frequented by predators (Parrish 1989). Furthermore, the turbid waters in these areas may decrease the foraging efficiency of predators (Blaber and Blaber 1980)

Coral reef fishes often use shallower habitats as juveniles (Lindeman et al 2000) and various combinations of these habitats may be used during adult diurnal feeding migrations or seasonal shifts in cross-shelf distributions (SAFMC 2009). Nagelkerken et al. (2000) document that Lutjanidae and Haemulidae settle in seagrass beds rather than on reefs. Other species represented in seagrass beds and mangrove estuaries include juvenile mutton, gray, dog, lane (*Lutjanus synagris*), and yellowtail snappers; and goliath, red, and gag groupers; and hogfish (SAFMC 2009). In addition, early juvenile Nassau grouper (*Epinephelus striatus*) have also been found to use macroalgal habitats along mangrove-lined channels (Eggleston 1995). Habitats within Port Everglades may provide EFH for newly settled stages of mutton snapper, which are known to occur in seagrass habitats (Gilmore, unpubl. data) and generally use mangrove prop roots or adjacent shallow rock and coral reef formations as larger juveniles (Gilmore, unpubl. data). Similarly, Mumby et al. (2004) found that the community structure of coral reefs was influenced by the presence of mangroves in the vicinity, and the total adult biomass of several species was higher.

In addition to occupying habitats, the habitat mosaic in the Port Everglades area also provides important energy exchange. For example, white grunts (*Haemulon plumier*), which are fished commercially and recreationally throughout their range (Potts and Manooch 2001), are important in energy exchange between reef and seagrass communities (Darcy 1983). As mentioned in the soft bottom habitats section, adult white grunts are generalized carnivores which feed mainly on benthic invertebrates (Potts and Manooch 2001). These include echinoderms, polychaetes, majid crabs, alpheid shrimp, isopods, other shrimp, crabs, and small fish (Randall 1967; De Silva and Murphy 2001; Darcy 1983). Because of their abundance, they are probably important prey for many larger species of groupers and snappers (Darcy 1983).

Collections in both seagrass beds and mangroves suggest that there is an integral link between these habitats with tripletail, snook, gray snapper, red drum, and goliath grouper, for example, occurring over seagrass beds or other adjacent bottoms as adults or large juveniles, but using the mangrove prop-roots as habitat during juvenile stages. Spotted seatrout, striped and white mullets (*M. curema*) and great barracuda (*Sphyraena barracuda*) juveniles are also common inhabitants (SAFMC 2009). There are also recognizable and predictable interactions where different life stages of fish move between reefs and seagrass beds on a diurnal basis. The best known examples in Florida are species of grunts which utilize reefs by day and seagrass beds by night.

Two species known to be present within coral reef habitats within the Port Everglades expansion area, gray snapper and bluestriped grunt, use vegetated habitats during their ontogeny (Faunce and Serafy 2007). In this study, both species exhibited a three-stage ontogenetic strategy, including settlement and grow-out within seagrass beds, expansion to mangrove habitats, and increasing utilization of inland mangroves during the dry season and with increasing body size. They also observed that for fishes inhabiting mangroves, the distance from an oceanic inlet and water depth were stronger predictors of reef fish utilization than factors like latitude, temperature, or habitat width. These findings highlight that the nursery function of mangrove shorelines is likely limited to the area of immediately accessible habitat, and that more expansive mangrove wetlands may contain a substantial number of larger adult individuals. It has also been suggested that the presence of mangroves and seagrass beds serve as extra “waiting

room” habitats for juvenile coral reef fishes, and that adopting such a life-history strategy may buffer against poor recruitment years (Parrish 1989).

The Port Everglades expansion area landscape provides for an important and complex set of ecological linkages between coral reef, mangrove, seagrass, soft bottom, and coastal inlet habitats in terms of flux of energy and physical occupation of habitats. Complex modeling studies would be needed to examine how fish would respond to the synergistic effects of the losses of multiple habitat types that support various life stages of fishery resources within the Port Everglades expansion area.

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